E ENGINEERING CONSTRUCTION WEEKLY

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February 3, 1938

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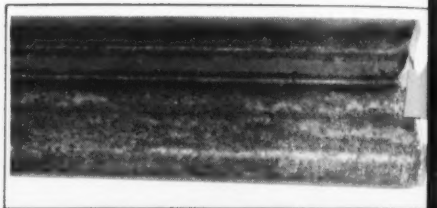
TRUSCON *Steel* WINDOWS
BONDERIZED ARE
RUST-RESISTING

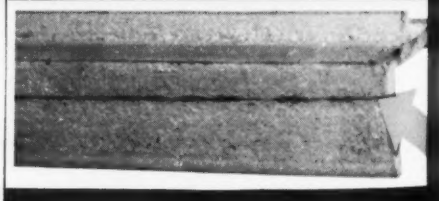
Even when the paint film on BONDERIZED steel is broken by scratching or other abrasion, BONDERIZING confines rust to the damaged area. It will not spread and break down great portions of the finish.

New BAKED-ON FINISH is Smooth Yet Tough and Durable. Priming Coat Lasts Three to Five Times Longer.

● Again TRUSCON, world's largest manufacturer of steel building products, moves forward with American Industry in the scientific war against metal corrosion and in protection of painted metal surfaces. ● TRUSCON has installed complete equipment for BONDERIZING...the well-known rust-resisting process used by automobile manufacturers and others to hold paint to steel and make steel resistant to the formation and progress of rust. ● Notably, in the automotive industry, BONDERIZING has proved its ability to help protect automobile paint finishes against the terrific abuse of flying gravel and stones, splashing mud, oils, destructive road chemicals, salt-saturated air and extremes of temperature. ● In the building industry, products of steel are subjected to similar but less violent forces of destruction. It is evident that the automobile proved process, BONDERIZING, plus the baking process, provide highly efficient protection for the priming coat on Truscon Steel Windows. ● TRUSCON'S new BONDERIZING equipment incorporates the latest developments in this rust-proofing process. You can specify TRUSCON *BONDERIZED* STEEL windows with assurance that the priming coat of paint as well as the steel itself is given the greatest practical protection for long life and low maintenance cost.



Steel window section painted but not Bonderized after 138 hours of salt spray test.



Truscon steel window section painted and Bonderized: after 228 hours of salt spray test.

Arrows indicate location of scratches inflicted in paint film of each specimen for testing. Note in upper illustration how the progress of rust has all but obliterated the scratch. In lower illustration rust is visible only in the scratch. It has not progressed under the paint film.

Bonderized Truscon Steel Windows are now available for immediate shipment from our factory in Youngstown, Ohio.

TRUSCON *Steel company*
YOUNGSTOWN • • • OHIO
57 SALES-ENGINEERING OFFICES
SUBSIDIARY: REPUBLIC STEEL CORPORATION

Now available—a new illustrated booklet explaining Truscon BONDERIZING facilities and what they mean to you. Sent promptly upon request. Write for it today.

· ENGINEERING NEWS-RECORD ·

McGRAW-HILL PUBLISHING COMPANY, INC.

WILLARD CHEVALIER, *Vice-President*

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VOL. 120 *FEBRUARY 3, 1938* No. 5

THIS WEEK AND NEXT

FLAT ARCHES of great span are achieved in a San Francisco livestock pavillion by supporting a central arch on cantilevers from the side walls.

Edward J. Mehren, formerly editor of Engineering News-Record, *and recently resigned president of Portland Cement Association, writes from New Zealand, telling of labor experiences in that country.*

No one knew what is the pull-apart strength of "metropolitan" joints in cast-iron pipe until the Baltimore bureau of water completed some special tests. The official report of these tests is given on page 180.

At Big Stone Lake on the Minnesota-South Dakota state line a gradually receding shore line has been restored by diverting the Whetstone River into the lake.

A good watermelon season in Charleston, S. C., means high operating costs at the new municipal incinerator where auxiliary fuel is used to burn wet refuse. Chance led to the discovery that discarded auto tires can be used in place of fuel oil.

A diversity of subjects was discussed by members of the American Society of Civil Engineers at meetings of the technical divisions of the society. Outstanding are fatigue tests on riveted joints, cost of generating power and stream pollution.

Wood preservation continues to be more extensively used in engineering structures. In this issue E. E. R. Tratman reports on the meeting of the American Wood Preservers Assn.

NEXT WEEK'S issue will be given over to a review of progress in civil engineering and construction in 1937. Construction statistics for the year will be presented together with comment on significant advances in several fields of engineering by well known authorities.

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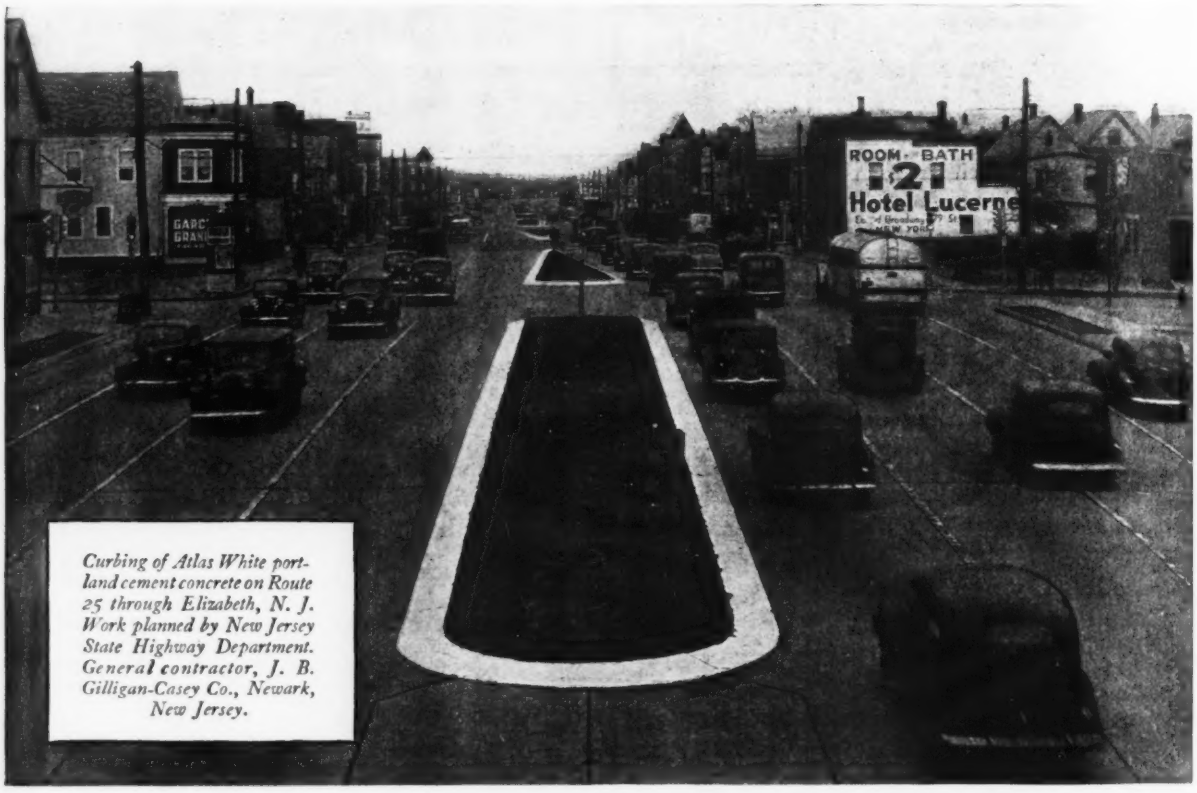
ON THE COVER—Tipping barge dumps Catalina rock on the last portion of the Los Angeles harbor breakwater at San Pedro. *Sawyer Photo*

Number of copies of this issue printed: 33,144

Greater Safety Greater Savings } For New Jersey Route 25



Curbing of Atlas White portland cement concrete on Route 25 through Elizabeth, N. J. Work planned by New Jersey State Highway Department. General contractor, J. B. Gilligan-Casey Co., Newark, New Jersey.

...Thanks to permanent curbing of Atlas White— always easy to see—never requires upkeep

● Traffic-laden New Jersey route 25—one of the principal highways from the south into New York—has some particularly busy sections. Example: the town of Elizabeth, shown above.

Before it was made into a dual highway, this roadway consisted of a center section carrying three lines of traffic in each direction, and two narrow roads—one on either side—separated from the main roadway by curbing. The old curbing was removed and the parkway of Atlas White portland cement concrete was built in the center to divide traffic.

The result is not only greater safety, but in the long run greater savings also, for these curbs are permanent —and permanently white. Maintenance will never be required.

Easy to install—in zero weather too

Atlas White curbing is placed easily and quickly. Neither specially trained labor nor costly equipment is needed. And the job can be done even in coldest weather. Pre-cast sections, made indoors, are simply moved to the job and set in place. Universal Atlas Cement Co. (United States Steel Corporation Subsidiary), 208 South LaSalle Street, Chicago.

M-18

ATLAS WHITE PORTLAND CEMENT FOR MARKERS AND CURBS

THE WEEK'S EVENTS

Record Ice Jam at Niagara Falls Wrecks Famous Arch Bridge

Falls View international arch, once longest in the world, collapses when pushed off foundation by ice flow

Irresistible pressure of the worst ice jam on record in the Niagara River Gorge tore the Falls View arch bridge from its foundations on Jan. 27 and completely wrecked the old structure, long known to millions of tourists as "Honeymoon Bridge." After standing against the continued shoving of the ice for 36 hr., during which time various structural members at the New York end bowed and buckled from overstressing, the 840-ft. span suddenly collapsed in a shower of snow and ice, coming to rest across the ice pack as a twisted, steel skeleton, partly shrouded by its own wooden deck (Fig. 1). At the time of its completion in 1898 the arch was the longest in the world.

The same ice jam almost completely filled the Ontario hydroelectric power plant on the Canadian side of the river (Fig. 3), clogged the intakes of the American hydroelectric plants and wrecked steamer wharves and many buildings at the lower end of the gorge. The disaster leaves but one highway connection between the twin cities of Niagara Falls, New York, and Ontario, namely the lower deck of and Ontario, this tie the lower deck of the railroad suspension bridge two miles downstream.

High wind causes jam

A combination of wind and weather caused the unprecedented ice jam. Several weeks of extremely cold weather had resulted in considerable ice forming in Lake Erie; then a short warm spell broke this ice loose from the shore. A high southwest wind following soon afterwards, on Jan. 24 and 25, blew the ice to the eastern end of the lake, where it was carried away by the Niagara River. The wind also raised the water level at Buffalo, the head of the river, about 6 ft.

The ice jam occurred mostly in the upper reaches of the gorge, between the foot of the falls and the American hydro-electric plant. Immediately below Horseshoe Falls, at the Ontario hydro plant, the ice piled up 60 ft. above normal water level. At the bridge, just below the American Falls, the height was about 50 ft. above the river.

Old structure light

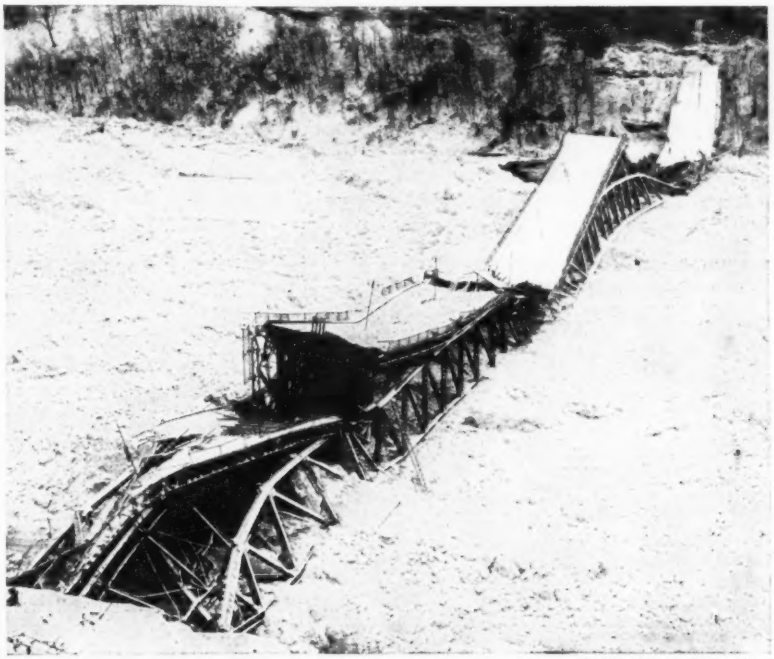
The old bridge, started in 1895 and completed three years later, was naturally of light design according to present-day standards (Fig. 4), though old accounts refer to it as "remarkably strong." It was designed by L. L. Buck, and built under the direction of R. S. Buck by the Pencoyd Bridge Co., of which C. C. Schneider was chief engineer.

The structure was a two-ribbed steel arch of 840-ft. span. Each rib was a two-hinged arched truss, 26-ft. depth of truss, 150-ft. rise. The chord members were plate and angle box sections; most of the struts and other bracing was of steel lattice construction. The spandrels were unbraced single columns supporting a wooden deck 46 ft. wide, including sidewalks. Orginally the roadway carried two street railway tracks.

At each end of the arch span was a 214-ft. bowstring deck span. In the entire structure were 2,300 tons of steel and 300 tons of timber.

The arch foundations were simple concrete and stone abutments, four in all, resting on the solid rock of the river shore about 40 ft. above normal water level. The anchorage pin bearing was a fabricated steel section supporting the pin casting; the upper bearing was a casting attached to the converging chords of the truss by bolting to a shoe plate. Alongside the down-

(*Continued on page 168*)



Buffalo Courier-Express Photo

FIG. 1—ONCE the world's longest arch span, the 40-year-old Falls View bridge at Niagara Falls lies in a tangled wreckage across the ice jam that caused the collapse of the structure.

Bay State Governor Favors Federal Flood Plan

Governor Hurley of Massachusetts announced last week his willingness to cooperate with the federal government on a proposal that all costs on flood control projects on the Connecticut and Merrimac rivers be met by the United States, and that the federal government hold title to the sites.

The Governor thus broke the solid front which the New England governors have presented against federal control of reservoir sites and power developments on the two rivers, ever since Congress refused to ratify interstate flood control compacts on these rivers on the grounds that they interfered with federal control over power developments. Governor Hurley announced his intention to support the McCormack Bill which provides for national control of reservoir and power sites and involves about $20,000,000 worth of construction in New England.

Governor Aiken of Vermont immediately opposed Governor Hurley's position, and Governor Cross of Connecticut has not yet indicated any change in his previously expressed position of opposition.

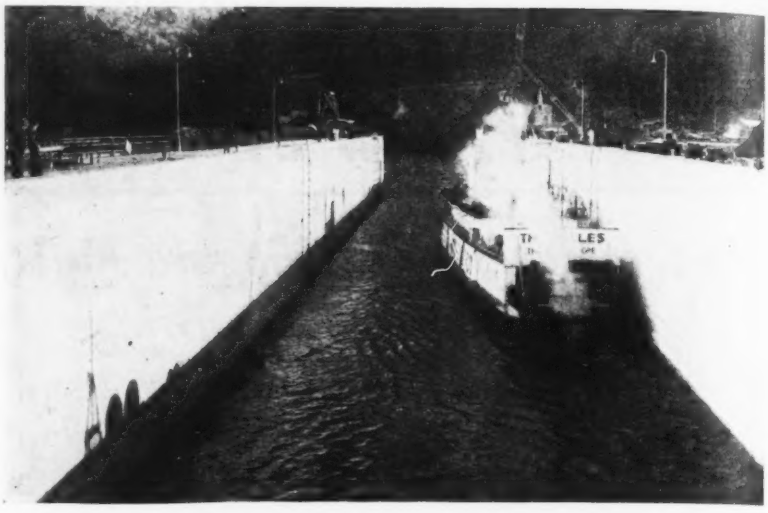
• • •

Connecticut Parkway Cost Probed by Grand Jury

An investigation of the activities of the Connecticut state highway department, particularly in connection with land purchases for the Merritt Parkway was begun in Bridgeport, Jan. 25, by a grand jury. The jury was summoned by State Attorney Willis to determine whether lands purchases at a cost totaling $6,100,000 for the $25,000,000 thirty-eight mile Merritt Parkway, were reasonable and whether further legal action may not prove to be necessary.

Summoning of the extraordinary grand jury came soon after Commissioner of Public Works Hurley had submitted a report to the Governor on the affairs of the state highway department.

At its opening session, the jury heard Charles F. Taylor, engineer of right-of-way for the highway department, and Highway Commissioner Macdonald was at a later meeting of the jury.



NAVIGATION BEGINS THROUGH BONNEVILLE DAM

THE WORLD'S HIGHEST lift lock went into operation at Bonneville Dam on the Columbia River Jan. 5. Water in the pool behind the dam was raised to El. 48, and river boats and barges were put through the locks for regular run upstream to The Dalles, Ore., 50 miles above.

When the pool is brought to normal depth, the lock will have a maximum lift of 66 ft. and a low water clearance over the sill of 27 ft. At present, navigation is limited to boats with a maximum draft of 8 ft., which is all the clearance now available over the sill, and the lift is 36 ft.

The spillway and control gates are now in full operation. The next step in raising the pool will be to bring it to El. 67 to operate the fishways.

Roebling Sues District On Gate Bridge Bands

John A. Roebling's Sons, cable contractors on the Golden Gate Bridge, have entered suit against the Golden Gate Bridge and Highway District to obtain $235,000 in payment for allegedly defective cable bands which were rejected by the district after they had been delivered.

A claim for the amount has been before the district directors for several months.

ENGINEERING CONSTRUCTION CONTRACTS REPORTED BY *ENGINEERING NEWS-RECORD*, IN JANUARY, 1938

Engineering News-Record *reports projects of the following minimum cost: Water-works, excavation, drainage and irrigation,* $15,000; *other public works,* $25,000; *industrial buildings,* $40,000; *other buildings,* $150,000.

Four Weeks — Thousands of Dollars (000 Omitted)

Public Works	New England	Middle Atlantic	South	Mid West	West of Mississippi	Far West	United States January 1938	United States January 1937	Canada
Waterworks	169	581	224	231	879	689	2,773	10,480	205
Sewerage	310	3,914	2,012	2,453	2,281	1,166	12,136	10,769	120
Bridges, public	58	1,091	1,450	1,376	1,022	988	5,985	10,584	2,500
Earthwork and waterways	766	5,286	1,347	251	1,023	1,613	10,286	8,918	20
Streets and roads	524	6,354	7,210	3,493	7,322	3,288	28,191	23,201	184
Buildings, public	1,565	14,701	4,350	6,634	6,334	4,156	37,740	29,215	331
Unclassified, public	509	5,408	82	3,135	2,852	1,622	13,608	8,658	63
Total public	3,901	37,335	16,675	17,573	21,713	13,522	110,719	101,825	3,484
Federal government (included in above classifications)	792	5,741	2,649	235	1,141	2,354	12,912	12,145	.....
Private									
Bridges, private	.....	.....	.....	.....	135	.....	135	1,765	.....
Buildings, industrial	1,140	4,070	1,910	7,205	9,584	2,729	26,648	42,523	278
Buildings, commercial	1,100	28,427	8,625	590	6,369	1,050	46,161	17,693	.....
Unclassified, private	47	771	3,757	363	1,342	243	6,523	9,271	300
Total private	2,287	33,268	14,292	8,158	17,440	4,022	79,467	71,252	578
Total Engineering Construction									
January, 1938 (4 weeks)	6,188	70,603	30,967	25,731	39,153	17,544	190,186	.....	4,062
December, 1937 (5 weeks)	8,649	67,027	22,875	36,730	39,623	24,129	199,033	.....	10,188
January, 1937 (4 weeks)	6,754	58,741	30,563	27,232	34,805	14,982	.....	173,077	4,323

THE CURRENT TREND

This week's news of contract volume and construction cost factors

THIS WEEK'S FIGURES

(Thousands of Dollars)

CONTRACTS

	Week Ending Feb. 4 1937	Jan. 27 1938	Feb. 3 1938
Federal	$4,723	$5,630	$35,181
State & Municipal	22,868	23,937	14,049
Total public	$27,591	$29,567	$48,230
Total private	13,860	21,182	21,578
TOTALS	$41,451	$50,749	$70,808
Cumulative 1938 (5 weeks)			$260,994
1937 (5 weeks)			$214,528

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works $25,000; industrial buildings, $40,000; other buildings, $150,000.

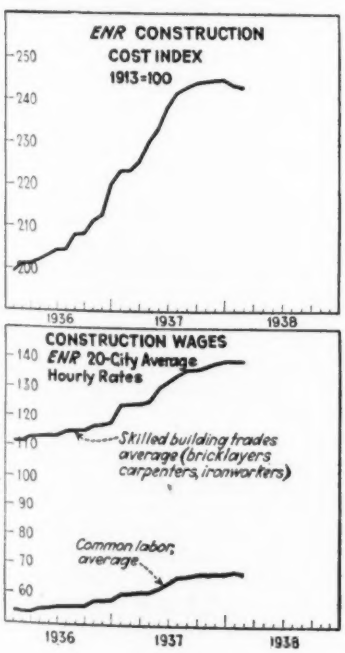
NEW PRODUCTIVE CAPITAL

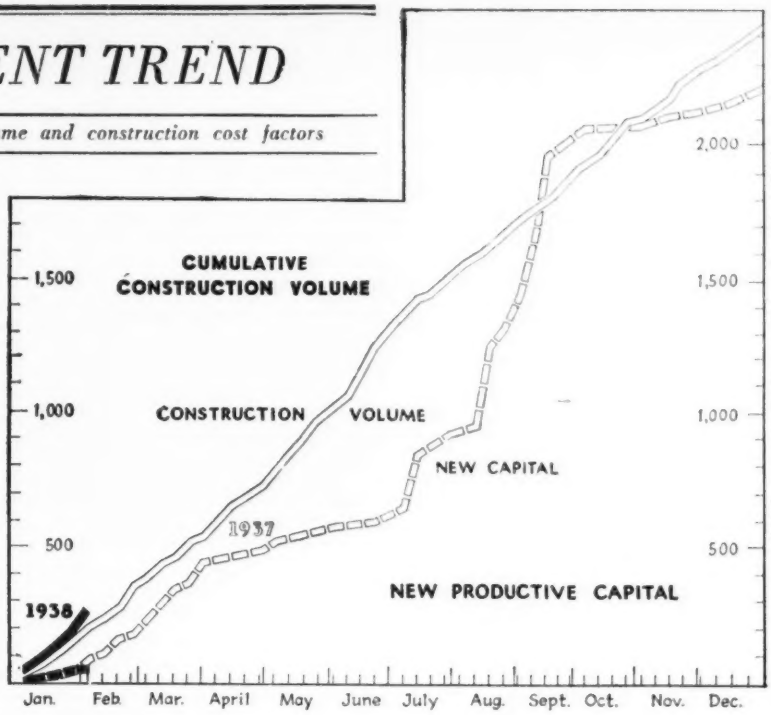
	Cumulative 1937 5 Wk.	1938 5 Wk.
NON-FEDERAL	$99,201	$50,260
State & mun. bonds	48,259 †	35,788
Corporate securities	55,003	11,230
PWA loans, grants	—4,061 †	1,141
RFC loans	.....	2,101
FEDERAL	.....	.....
TOTAL CAPITAL	$99,201	$50,260

† Represents transfer from federal to private investment financing through sale by RFC of PWA bonds.

ENR INDEX NUMBERS

COST Base = 100	1913	1926	VOLUME	1913	1926
Feb., 1938	243.39	117.00	Jan., 1938	168	74
Jan., 1938	243.85	117.22	Dec., 1937	141	62
Feb., 1937	223.45	107.41	Jan., 1937	167	73
1937 (Av.)	236.41	113.63	1937 (Av.)	171	75
1936 (Av.)	206.41	99.22	1936 (Av.)	185	81
1935 (Av.)	195.22	93.84	1935 (Av.)	135	59





THE MONTH'S SCOREBOARD

CONSTRUCTION VOLUME

(,000 omitted)	January 1937	1938	% Change	Dec. 1937*	Jan. 1938	% Change
Total	$173,077	$190,186	+10	$199,033	$190,186	+20
Private	71,252	79,467	+12	67,689	79,467	+47
Public	101,825	110,719	+ 9	131,344	110,719	+ 5
Federal	12,145	12,912	+ 6	24,020	12,912	−33

NEW PRODUCTIVE CAPITAL

(,000 omitted)						
Total	$40,530	$44,399	+ 9	$91,811	$44,399	−40
Private Investment	44,591	41,258	− 8	91,811	41,258	−44
Federal (non-fed. wk.)	−4,061	3,141	....	.....	3,141	....

* Five-week month.

CONSTRUCTION COSTS . . . WAGE RATES . . . PRICES

	February 1937	1938	% Change	Change Jan. to Feb. 1937 Jan.	Feb.	%	1938 Jan.	Feb.	%
ENR Construction Cost Index, 1913 = 100	223.45	243.39	+ 9.0	223.45	223.45	0	243.85	243.39	−0.2
ENR 20-CITIES' AVERAGE									
Common Labor	$.603	$.675	+12.0	$.603	$.603	0	$.680	$.675	−0.7
Skilled Labor	1.244	1.391	+12.0	1.240	1.244	+0.3	1.391	1.391	0
Bricklayers	1.313	1.480	+13.0	1.313	1.313	0	1.480	1.480	0
Struct. Ironworkers	1.308	1.442	+10.0	1.295	1.308	+1.0	1.442	1.442	0
Carpenters	1.111	1.251	+13.0	1.111	1.111	0	1.251	1.251	0
Cement, per bbl.	$2.54	$2.54	0	$2.55	$2.54	−0.4	$2.53	$2.54	+0.4
Reinforcing steel, new billet	2.78	2.91	+ 4.7	2.69	2.78	+3.3	2.91	2.91	0
Struct. Steel, Pittsburgh	2.05	2.25	+ 9.8	2.05	2.05	0	2.25	2.25	0
Sand, per ton	1.17	1.25	+ 7.0	1.15	1.17	+1.7	1.24	1.25	+0.8
Lumber, 2x4 Fir per M	35.88	34.49	− 3.9	35.47	35.88	+1.1	34.74	34.49	−0.7
Lumber, 2x4 Pine per M	33.21	29.09	−12.3	32.06	33.21	+3.5	29.24	29.09	−0.5
Brick, Common, per M	13.90	13.24	+ 2.6	13.58	13.90	+2.3	14.16	14.24	+0.6
Ready-mixed Concrete	7.19	7.29	+ 2.8	7.14	7.19	+0.7	7.39	7.39	0
Struct. Clay Tile 3x12x12	74.08	74.55	+ 0.6	72.47	74.08	+2.2	72.71	74.55	+2.6
Paving Asphalt, cars, ton	17.11	16.84	− 1.6	17.05	17.11	+0.3	16.98	16.84	−0.8

MATERIAL SHIPMENTS . . . BUILDING PERMITS

	January 1937	1938	% Change	Dec. 1937	% Change Dec.–Jan.
Lumber (% 1929 wk. av.) N.L.M.A.	50	38	−24.0	42	− 9.1
Steel A.I.S.I. (% operating capacity)	79.2	29.0	−63.0	25.4	+14.0

	December 1936	1937	% Change	Twelve months 1936	1937	% Change
Fabricated Struct. Steel (A.I.S.C.)*	121,775	108,396	−11.0	1,548,205	1,660,570	+ 7.2
Cement, Thous. Bbl. (U.S.B. of M.)	6,246	4,780	−23.0	112,566	113,997	+ 1.2
Building Permits, Dun & Bradstreet (,000 omitted)	$83,557	$118,764	+42.1	$980,497	$1,130,624	+15.3

* Subject to revision.

RENT INDEX

	December 1936	1937	% Change	Nov. 1937	% Change
Rent (housing) Index, N.I.C.B.	81.8	88.7	+8.5	89.1	−0.5

Contract Let For Coulee High Dam

Interior Construction Co. receives contract but only $15,000,000 is available for first year

A contract for the completion of the high dam at Grand Coulee, on the Columbia River, was awarded Jan. 28 to the Interior Construction Co. of Oakland, Calif., for $34,442,240. The contract also covers construction of the west powerhouse superstructure and appurtenant works. The successful bidder is a newly-organized combination of contractors including the builders of Boulder Dam and the lower section of Grand Coulee. Its ten members are: Silas Mason Co., New York City; Walsh Construction Co., Davenport, Ia.; Atkinson-Kier Co., San Francisco; Morrison-Knudsen Co., Boise, Idaho; J. F. Shea Co., Los Angeles; McDonald & Kahn, Los Angeles; Pacific Bridge Co., San Francisco; Henry J. Kaiser Co., Oakland; Utah Construction Co., Ogden; General Construction Co., Seattle. The first three were contractors on the first contract for the foundation dam, under the familiar M. W. A. K. Co. name.

Magnitude of contract

The contract involves manufacturing and placing about 5,250,000 cu. yd. of concrete, which will bring the dam to its full height of 553 ft., and placing 160,000,000 lb. of reinforcing steel, 10,000,000 lb. of pipe, 50,000,000 lb. of gates and operating devices, 24,000,000 lb. of trash rack metal, and 16,000,000 lb. of penstock. It does not include furnishing any materials except sand and gravel, which will be excavated from a site near the dam. (A separate contract for 1,700 tons of deformed reinforcing bars was awarded on the same day to the Columbia Steel Company of Denver.)

The contractor will have four years in which to finish the work. He must post a performance bond of $5,000,000 and a labor and material bond of $2,500,000.

The only other bid submitted, amounting to $42,185,802.50, was placed by Pacific Constructors, Inc., of Los Angeles, a combination of eight contractors.

Not much money

Less than $2,000,000 remains of the money already appropriated for Grand Coulee. The present budget carries an additional $13,000,000. More than this amount could be expended to advantage during the first year of this contract, but there is little likelihood that the appropriation will be increased. The $15,000,000 must cover purchase of raw materials and equipment as well as payments under the contract. Gates and pipe, along with other equipment and raw material, will take half of the $15,000,000.

A reasonable contract

Commenting on the award of the contract John C. Page, the Commissioner of Reclamation, said: "The bid compares favorably with estimates made by our own staff. Its reasonableness cannot be challenged successfully. Indications point to an early start on the contract and to its orderly progress."

The bids were opened Dec. 10 at Spokane.

Wide World Photo

LIGHTING ON NEW DELAWARE RIVER BRIDGE

Effectiveness of the lighting equipment of the new bridge across the Delaware River on a rainy evening is shown above. The bridge, between Easton, Pa. and Phillipsburg, N. J., was built by the Delaware Joint Bridge Commission and was dedicated Jan. 14 by Pennsylvania and New Jersey governors.

New York May Drop Performance Bonds

Performance bonds would be dropped on all construction contracts let by New York City under the terms of a new set of rules governing city contracts which has been introduced into the Board of Estimate with administration support. The administration controls 15 of the 16 votes of the Board of Estimate and Apportionment.

At present the city carries no insurance against accident claims or against fires in city buildings.

Colorado-Big Thompson Project Halted

A technical flaw in the authorization act has prevented the start of construction of the Colorado-Big Thompson reclamation and power project, which will divert water from the western to the eastern slope of the Continental Divide through a 13-mile tunnel under Rocky Mountain National Park as well as generate power.

In the original authorization of the project, it was revealed Feb. 1 by Commissioner of Reclamation Page, Congress provided that construction work should not start until contracts had been signed by local interests guaranteeing full repayment of federal advances through project revenues. This would require a guarantee not only of the $25,000,000 estimated cost chargeable to reclamation, but also of the $19,000,000 additional covering the ultimate power development.

The local reclamation district, however, has no authority to engage in the power business, and the plans for development contemplate that the federal government shall retain control of and market the power. Consequently, the authorization must be revised before construction can start unless the local district is willing to assume responsibility for power revenues over which it will have no control. The district is unwilling to do this, and work is held up until Congress changes the authorization.

Big Housing Program Proposed for New York

Mayor La Guardia, of New York City, has proposed to the Board of Estimate that the city guarantee the interest on bonds of the New York City Housing Authority to permit a large scale program of construction of houses in the rental range of $20 to $30 per month, in addition to whatever program is carried out under the federal housing program.

The Mayor suggests that the city immediately appropriate $500,000 to guarantee interest on $16,000,000 of bonds of the housing authority. He further suggested that the city later increase its contribution to about one-half per cent of the city budget, amounting to about $3,000,000 a year, and thus guarantee interest on about $100,000,000.

The plan was endorsed on behalf of the American Labor Party by majority leader Vladeck of the City Council. He said that "the Mayor's program, carried to its logical conclusion, may rehouse, under the city's auspices alone, an average of 8,000 families a year, or 80,000 over a period of ten years."

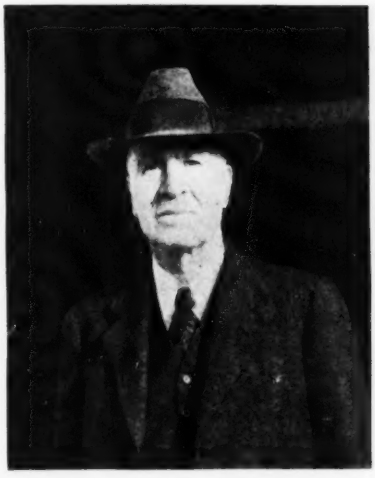
Tunnel Bids Called At Shasta Dam

Bids for construction of a quarter-mile railroad diversion tunnel under the west abutment of the Shasta dam in the Sacramento River canyon, will be opened Feb. 21 by the Bureau of Reclamation.

Under an agreement with the Southern Pacific R. R., the railroad's line through the Sacramento canyon will be temporarily routed through the tunnel during construction of the dam. This will permit an immediate start on the dam, and it is expected that bids will be called for in March. Ultimately, the railroad will be routed over a 30-mile relocated line, and the tunnel will be used for water diversion.

The tunnel will be a single-track horseshoe section, 23 ft. high. The successful bidder will be allowed 150 days in which to complete the job.

Bids will be opened at the same time on 16 motor-driven vertical pumps to be installed in the four pumping plants of the Contra Costa canal near Oakley.



RETIRES FROM AQUEDUCT

JAMES MUNN resigned his position as general superintendent of construction of the Metropolitan Water District of Southern California on the first of the year and announced his retirement from engineering work. Mr. Munn came to this country from Scotland as a young man to enter the engineering profession. From 1891 until he joined the U. S. Bureau of Reclamation in 1909, Mr. Munn was in private practice in general construction and engineering contracting. While with the bureau, Mr. Munn was construction superintendent on many projects, and from 1917 until 1924 he was in charge of all cost keeping and engineering administrative work for the service.

In 1924 Mr. Munn took general charge of construction of the Mokelumne water supply project of the East Bay Municipal Utility District at Oakland, Calif. He was chief of construction of the major dam division of the Los Angeles Water Department from 1929 to 1930, and since that time he has been general superintendent of construction of the 392-mile Colorado River acqueduct.

State Held Liable For Falling Rock

The state of New York is liable for damages from rock falling from an overhanging cliff or mountainside to persons and vehicles traveling along highways, the state Court of Appeals held Jan. 27.

The court made its ruling in sending back to the Court of Claims for the assessment of damages a suit brought against the state by Edward C. Doulin. He sought to recover damages to his car when rock fell on it on the Storm King Highway. The Court of Claims had decided against Mr. Doulin.

Building Dept. Work Is Outlined

Murdock tells Building Congress how N. Y. City department functions under new charter

For the first time in New York City all department heads having to do with construction and inspection are responsible to the Mayor, Harris H. Murdock, chairman of the New York City Board of Standards and Appeals, told members of the New York Building Congress, Jan. 26. They were gathered at a luncheon celebrating the appointment of Alfred Rheinstein, New York City contractor, as commissioner of housing and building and member of the city housing authority.

Describing the functions, under the new charter and building code, of the department which Mr. Rheinstein will head, Mr. Murdock pointed out that the Department of Housing and Building includes the functions of the former borough departments of buildings and the former tenement house department. The borough officers are retained as branches, and the head of each branch is a superintendent with exclusive jurisdiction over approval of plans and issuance of permits in his bureau. The superintendents may, in specific cases, permit the substitution of materials for construction other than those provided in the code. Recourse from a superintendent's decision may be had through the Board of Standards and Appeals.

Exclusive power is vested in the board to test and approve materials and construction methods, and to make all rules necessary.

Other speakers were Matthew W. Del Gaudio, chairman of the joint committee of architectural societies of the metropolitan area; Lou R. Crandall, president of the Metropolitan Building Association; and Thomas S. Holden, president of the New York Building Congress.

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Equipment Makers Victims Of Check Swindler

Manufacturers of mining equipment and machinery in widely separated parts of the country have been the victims of a check swindler who poses as a mine owner placing orders for mining and milling machinery. He offers a certified check on a Western bank in payment, the check being for an amount somewhat larger than the price of the machinery. After he has collected the difference, the check is found to be a forgery.

Resettlement Rents Set at Cincinnati

Rentals for $6,780 dwelling units will range from $18 to $42 per month

Rentals for the 676 residential units in Greenhills, suburban housing project near Cincinnati, have been set by the Farm Security Administration at an average of $5.52 per room per month. A minimum of $18 per month will be charged for a one-bedroom apartment, and the highest rent will be $42 for a four-bedroom, single-family dwelling.

Objective in setting up the rentals was to make the homes available to families in the income range of $1,000 to $2,000; to derive sufficient revenue to meet operating costs; and to return as much as possible of the annual receipts to the federal government. With the rental schedule which have been set, it is expected that $75,000 will be returned to the government.

Substantial buildings

All houses have hardwood floors, copper plumbing, modern kitchens and baths and large closet space. They are insulated and have soundproof walls. Each residence has an electric range, water heater and refrigerator as permanent equipment.

Heat will be furnished by the tenants in single-family dwellings, and in the apartments heat and janitor service will be provided at a cost of about $4.20 per month. Water is provided at the prevailing county rates, electricity is bought wholesale by the project and distributed to the tenants at a flat rate based on size of unit and amount of equipment, and telephone service is available. Garages are provided for 60 per cent of the residences and are charged for separately.

Utility services

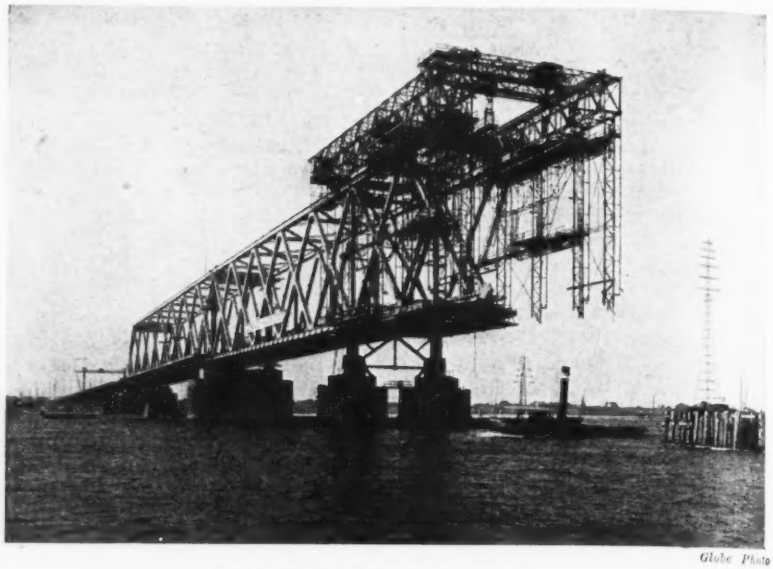
Greenhills has 5.2 miles of surfaced streets, 18.3 miles of sewer, and 18.6 miles of water mains, as well as street lighting, traffic control, and fire alarm systems, and a village incinerator. Public service facilities were designed to serve 1,500 families. The community will be incorporated as a village and have its own local government under forms provided by Ohio law. The residents will elect their own officials, and the village will support its school and services, and pay the county and township for services provided by these agencies.

The total cost of the project will be $11,377,000 of which $2,444,000 were used for land acquisition, inspection, and planning. Actual cost of the 676 dwelling units was $5,492,000. Surveys and land separation cost $515,000; streets and sidewalks $474,000; utilities $1,152,000; and community and commercial buildings and recreation centers cost $997,000. Thus the average cost of construction per dwelling unit, exclusive of land, is about $8,240. If to this is added a prorated share, based on an ultimate population of 1,500, of the cost of public facilities, the cost per dwelling is brought to $10,410.

Relief labor

Since primary consideration was given in the construction of Green hills to the employment of the maximum amount of relief labor, the Farm Security Administration estimates that of the total charge of $5,880,000 for labor on the construction work about 24.8 per cent should be charged to relief. If this adjustment in labor cost is made, the adjusted cost of construction of the 676 residences would be $4,586,000, or $6,780 per dwelling unit.

Costs additional to the actual cost of the dwelling units themselves, pro rated on the basis of the ultimate population of the village and with a deduction made for relief charges, are: roads and utilities, $904 per dwelling unit land preparation, surveys and grading, $273; village land, $216. These bring the adjusted cost of the project per dwelling unit, exclusive of improvements outside the village limits and of community buildings and recreation centers to $8,173. The total construction cost on the adjusted basis, including rural improvements, is $7,477,000.



Globe Photo

NEW BRIDGE ACROSS THE RHINE

A BRIDGE 1,340-ft. long was recently completed across the Rhine, connecting Duisburg with the west bank, after 2½ years of construction. The bridge carries a 40-ft. roadway, a 5-ft. bicycle path, and a 9-ft. sidewalk. Provision is also made for later installation of a two-track street-car line.

The view above shows the bridge during construction.

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New York Names Markham Works Commissioner

Major-General Edward M. Markham, who completed a four year term of service as Chief of Engineers last October, has been appointed by Mayor LaGuardia of New York City as Commissioner of Public Works. General Markham is now in Honolulu on a number of unofficial projects and is expected to retire from the Army in a few days.

Senate Approves Housing Bill

The Senate, on Feb. 1, completed congressional action on the housing amendments by adopting the report of the conference committee without change. The bill now goes to the White House for approval. By approving the report the Senate rejected the lodge amendments requiring that prevailing wages be paid on construction insured by FHA.

High Court Upholds Tax on Contractor

Tax on income of Bonneville Dam contractor held to be within powers of state

The U. S. Supreme Court, which held last December that states may tax the gross receipts of contractors on federal projects (*ENR*, Dec. 9, 1937, p. 915) held in a decision handed down Jan. 31 that an income tax on the net income of the Guy F. Atkinson Co., contractors on certain work at Bonneville Dam, was legal.

The Oregon Supreme Court had decided in favor of the state, and the case was brought to Washington on appeal.

The contractors advanced two contentions: that the tax is a burden on the operations of the federal government; and that the area within which the work was done is within the exclusive jurisdiction of the United States.

On the first of the contractor's contentions, the court held that the question had already been decided in the cases of last December. At that time the court ruled that the mere fact that a tax on the contractor's receipts might increase the cost of the federal government's operations did not render the tax a tax upon the government.

The question of the jurisdiction of the United States, was divided by the court into two parts: land in the bed of the river, and dry land. Although an Oregon statute gives the Governor the right to cede lands underlying waters of the United States to the federal government upon application, the Oregon Supreme Court pointed out and the high court agreed that no evidence had been produced that the federal government had made any such application.

As regards dry land, the contractor rested his case on an Oregon statute giving consent to the United States to purchase or otherwise acquire lands within the state for the purpose of erecting public buildings and giving the United States the right of exclusive jurisdiction over such land. On this point the court pointed out that a grant of authority does not have to be accepted and that the "mere fact that the government needs title to property within the boundaries of a state does not necessitate the assumption by the government of the burdens incident to an exclusive jurisdiction."

The contract under which the Atkinson Co. operated requires the contractor to come under the provisions of the workmen's compensation law of the state, and the court held that the "enforcement and administration of the Oregon compensation law . . . were incompatible with the existence of exclusive legislative authority in the United States."

"There is no warrant," the court held, "for the conclusion that the state did not retain its territorial jurisdiction over the area in question so far as its exercise involved no interference with the carrying out of the federal project. . . . We have decided that there is no such interference through the enforcement of a tax such as is here assailed."

Governor Confers on Utility Purchase

No official comment has been offered by either participant in the White House conference at which Gov. Browning of Tennessee presented his plan for joint federal-state action in the purchase of Tennessee Electric Power Co. properties. Washington observers, however, attach significance to the fact that no director of the TVA bothered to attend the meeting, although David E. Lilienthal has been authorized by the board of directors to conduct any preliminary negotiations with the private utilities that may seem advisable.

The Governor proposed that the company's properties be divided between TVA, which would take over generating and transmitting facilities, and one or more power districts to be organized in the territory now served by the company, which would handle distribution to consumers. The districts would be empowered to issue bonds in order to obtain funds for payment to the utility company.

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Domestic Construction Proposed for Ulen & Co.

A proposal that Ulen & Co., which heretofore has devoted itself almost exclusively to foreign construction work, enter into domestic construction and a general engineering practice is to be put up to the stockholders of the company at a special meeting to be held on Feb. 17. It is also proposed that James H. Manning, former president of the Stone & Webster Engineering Corp., be named president of Ulen & Co.

WASHINGTON HIGHLIGHTS

Special reports by Paul Wooton

AFTER TRAVELING 9,000 miles visiting various reclamation projects, the Reclamation Repayment Commission has returned to Denver and begun work on its report. The commission will come to Washington before the end of February to submit its conclusions.

The commission was set up under a special act of Congress. Its principal duty is to propose a plan that will make further blanket moratoria on water-users payments unnecessary. It also is to report on cases where 1937 payments should be eliminated because of adverse conditions on the project. The commission has no authority to reduce the total obligation for repayment.

A BILL to authorize Captain William Bowie, retired, of the U. S. Coast and Geodetic Survey, to accept the order of Orange Nassau bestowed on him by the government of the Netherlands has been introduced into Congress by Sen. Pittman of Nevada, chairman of the foreign relations committee.

COMMENTING upon the Wagner low-cost housing act during a recent Washington visit, Sir Raymond Unwin, British housing authority and past president of the Royal Institute of Architects, suggested that although the plan for housing slum dwellers is generally workable, it contains a number of unnecessary complications. His criticism was directed principally at the requirement that local authorities provide 10 per cent of the cost of a project and at the limitation of cost written into the act. He also pointed out that in England demolition of slum dwellings is postponed until new accommodations are ready for occupancy.

THE CHESAPEAKE AND OHIO RY. CO. on Jan. 26 asked the Interstate Commerce Commission for authority to build 6.6 miles of new line in Boone County, W. Va., from near West Junction to a point near Bandy.

THE RECLAMATION FUND would receive 52½ per cent of receipts from Naval petroleum reserves outside of Alaska under the terms of a number of bills which have been introduced in Congress and are now in committees. Extra money for reclamation from this source would amount to about $26,000,000.

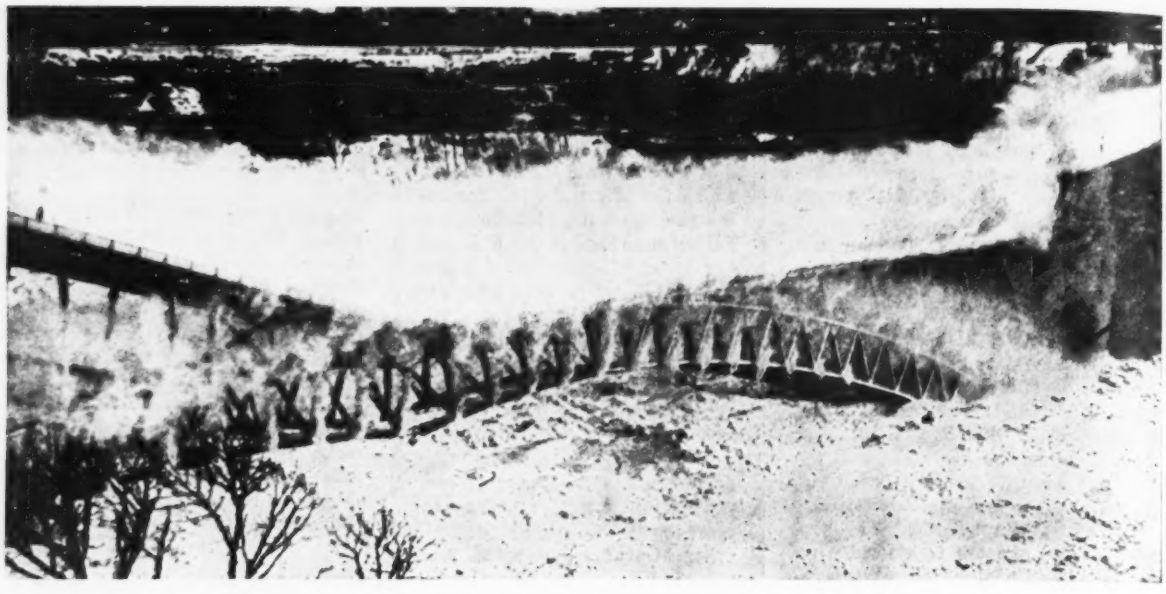

FIG. 2—THE FAMOUS old span plunges into the gorge enveloped in a shroud of snow and ice.

Ice Wrecks Bridge At Niagara

(Continued from page 161)

stream edge of the New York abutment is the outlet of the Adams hydroelectric power plant discharge tunnel. A heavy retaining wall extending back to the tunnel portal protects the abutment.

History of the site

The site has been used for a bridge since 1868, when a suspension bridge with wooden towers and floor system was completed. In 1887 and 1888 the towers and deck were replaced with steel construction. On Jan. 10, 1889, the entire deck was carried away by a windstorm. The structure was hurriedly rebuilt and opened to traffic, but its inadequacy soon led to a decision to build the arch span which was begun in 1895.

Ice jams are common in the gorge, but apparently there was no record or evidence of ice high enough to damage the bridge at the time it was built. However, in 1909 the ice jammed up against the lower ends of the arches with sufficient force to damage some of the lower bracing and struts. These were replaced and strengthened at the time, and a curtain wall was built around the front and sides of the abutments to prevent ice from jamming between the skewbacks. The lateral bracing system of both chords consisted of a series of latticed four-angle diagonals, mostly without direct cross struts. At the time of the 1909 strengthening, sub-bracing of short triangular frames was added to the lateral bracing at the extreme ends of the chords, the points of the frames bearing against the lower chords midway between panel points.

Nature of failure

The ice jam formed Tuesday night, Jan. 25, and by 3 A.M. Wednesday had piled up to a height of 50 ft. above normal river level at the bridge at the American end, and to a lesser height at the Canadian end. At the New York abutments the ice was 10 ft. above the pins, well into the trusses (Fig. 5). Early Wednesday morning the ice pack moved downstream like a glacier for about 400 ft. At least 30 ft. of the upstream truss was buried in the ice at this time and during the movement sheared off the top of the ice pack. The truss and the lateral bracing suffered severe damage; many of the bracing members failed under the strain. Shortly after daylight, when the conditions became known to the owner of the bridge, the International Railway Co., the structure was closed to traffic.

Wright & Kremers, Inc., contracting firm of Niagara Falls, was called on the scene by H. E. Rexinger, chief engineer of the International Railway Co.; P. L. Pratley, of the consulting firm of Monsarrat & Pratley, Montreal, was also called in to try to save the structure. Plans were made to dynamite the jam at the abutments in an

Edwin H. Hodge photo

FIG. 3—ICE almost completely filled the Ontario powerhouse, causing unknown damage to the generating and auxiliary equipment.

effort to relieve the ice pressure, but were never consummated. It was thought at the time (Wednesday morning) that the upstream abutment was failing, and an attempt was made to dig down through the ice between the skewbacks and place timber cross struts to prevent further sliding or turning of the upstream masonry. However, this plan was never fully carried out. All of the trouble was at the American end.

At 1 pm. Wednesday another downstream movement of the ice occurred. This second shove further displaced the upstream lower chord, and further disrupted the bracing system. Chief damage, however, was a lateral buckling of the downstream lower chord at the junction of the point of the sub-frame between panel points, referred to above.

There was no further movement of the ice, but the upstream truss continued to move very slowly downstream. It was then realized that the connection of the arch to the upper pin casting had ruptured, and that the truss was sliding downstream off its feet. Eventually the end of the truss slid beyond the casting and kicked shoreward a slight distance, coming to rest deep in the ice.

Distribution failure

This movement of the upstream truss was accompanied by further buckling and failure of secondary members in the end area. From here on the failure of the structure was one of distribution of loads and stresses to members far inadequate to carry them. The downstream post carrying the outward end of the American shore span slowly buckled into a S in a plane parallel to the truss.

Collapse of the bridge was only a matter of time after the second ice shove, and it came at 4:12 p. m. Thursday, when the buckled section of the downstream lower chord finally broke with a loud report. In falling the deck broke at the junction of the shore spans and the arch, and at the center of the arch, and was badly torn at two or three other points. The American shore span dropped into the talus slope at the foot of the cliff, while the Canadian span was pulled into the gorge, coming to rest on top of that end of the arch.

Examination of the wreckage reveals that the upstream American pin castings are still in place, though pulled out of line slightly. The downstream pin castings on this side merely pulled apart, dropping the pin into the river. Upper and lower pin castings on the Canadian side also pulled apart. A section of the upstream upper chord on the American end of the arch broke loose from the truss and buckled into an inverted V at the river end of the shore span.

FIG. 4—OF LIGHT DESIGN according to modern standards, but still having many years of useful service in its frame, the bridge was doomed to failure shortly after this view was taken.

Wide World Photo

FIG. 5—SEAT of the trouble: ice shoving against the upstream truss at the American end of the arch resulted in rupture of the truss connection to the bearing pin and eventually caused the collapse of the bridge.

There is slight chance for salvage of the wreckage. Sunday night, with the jam starting to break up, the structure was slowly settling into the ice. In all probability the steelwork will plunge into the river with the first movement of the ice to a final resting place in 150 ft. of water.

Will replace at once

The International Railway Co. has announced its intention of replacing the structure at once. It holds a franchise on the site and intends to keep it by immediate rebuilding. Monsarrat & Pratley and the New York firm of Modjeski & Masters have been retained as consultants on the new design. The type of structure has not as yet been determined.

Ice and water were forced through the south (upstream) end of the Ontario power house, located at the river edge just below the Canadian Falls. Coming through the windows, 50 ft. above water level, the ice completely buried eight of the fifteen generators and partly covered the remainder.

A dragline crane is now excavating a roadway through the ice along the Canadian shore to provide access to the plant for a power shovel and trucks, which will be used for removal of the ice from within the building. Meantime the plant, of 205,000 hp. capacity, is shut down for an indefinite period. The Queenston plant, at the mouth of the gorge, is taking the Ontario plant load. This plant was threatened for a time by ice, but is now considered safe.

News continued on page 193

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FEBRUARY 3, 1938

HEAVY RAINFALL in the central valley of California last December, which caused high floods, did more than run up a $14,000,000 damage bill: it suggested to Forest Service officials the idea of putting high-water markers at important stream crossings and other prominent locations. There is good psychology in this move. Such markers, with appropriate notices, impress on the public the danger of floods more effectively than statistics can do; they are eloquent of submerged areas and property damage. This particular storm afforded excellent opportunity for a widespread movement of this sort because almost all streams in the northern part of the state were at exceptional levels. But the idea has quite generally application. Other regions would find advantage in such reminders, that would keep before every age even in periods of drought just what flood menace means.

Needless Restriction

FOR THE SECOND TIME a bill has been introduced into the New York state legislature to limit the employment of architects and engineers by the state and its cities. The proposed law would prohibit employment of persons not on civil-service preferred lists for architectural or engineering services so long as there are eligibles on these lists. The only exception is made for architects or engineers of "peculiar or exceptional qualifications", and these are to be employed in a consulting capacity only. In purpose this proposed change in the civil service law may be an innocent attempt to keep the state or its subdivisions from filling vacancies with men not on civil service lists, but it could be used to prevent the employment of independent engineers and architects to carry out construction of a sewage disposal system or a hospital. As the bill reads these men could not do the work with their own trained staff. They would have to recruit a green staff from civil service lists, possibly letting their own men go. This would seem to eliminate automatically the best consulting engineers and architects. Such legislation should be kept off the statute books of every state. States and their subdivisions should be free to call in specialists when the occasion demands, and those specialists should be free to use their own men, who contribute to the skilled professional service that the specialist has to offer.

Experience Abroad

HUMAN ADJUSTMENTS of the kind involved in labor relations are, if anything, more important to engineers than to other citizens, since their effect on costs and profit margins controls the scope of enterprise and thus influences engineering activity. It is this relation that gives engineering significance to labor experience abroad, in spite of differences in peoples, occupations and industrial conditions. E. J. Mehren's account of New Zealand labor developments and experiences therefore invites close study. Movements only now beginning in the United States have gone through half a century's test over there. Mr. Mehren, going to the heart of the situation by his inquiry into the attitudes of employer and employee groups and the general public, reports the outcome of the test to be generally satisfactory. The reader will note, of course, that the experience is that of a predominantly agricultural economy. The creative enterprise of industry, relatively unimportant in the antipodes but of great importance in our country, introduces a factor that may call for adjustments of different kind.

Lessened Protection

ON THE GROUND OF REFORM a rule against contract performance bonds on public-works construction has been adopted by New York City authorities. The plan of doing without bonds is described as "self-insurance" and is claimed to save public money by eliminating the cost of bond premiums from contract bids; to make these claims more palatable, charges of graft in past contract bonding are advanced. Of course "self-insurance" means that the public will carry the risks of contract performance, instead of being protected by a distribution of risk over many kinds of work, many localities and many conditions, including that of official fallibility. It will be interesting to watch whether bids on work will rise under the new ruling; the larger financial demands on bidders are likely to reduce competition, and the contractor's greater dependence on the intelligence and fairness of the official in charge will introduce a new risk: "Self-insurance" may be simpler and more convenient for the officials; for the public, however, it means lessened protection.

Brick Pavement Observations

PAVEMENT DESIGN encounters one of its hardest problems in the composite structure of the brick road. Brick, joint filler, bedding course and

base, all of different materials and reacting differently to temperature and moisture, have to be wrought into a rigid unitary slab. Not so many years ago this conception of concerted or unified action was uncommon; each element of the pavement was studied as an independent problem. Many experiences show how faulty this practice is. As an example: recent surveys of brick pavements in Ohio showed that failure of the base to keep moisture away from the bedding course caused the binder to leak out, permitting the brick above to settle and break the bond of the joint filler. It was not enough that the concrete base was strong in itself; it also had to protect the bedding course, in order to prevent joint and surface failure. In short, the brick, the joint filler and the bedding course have to do their own jobs and also help each other. Unless this concerted action results, brick pavement design falls short of success. It promises much to brick paving that design is now showing increased awareness of its fundamental problem—to create a pavement, not a number of separate pavement units.

Difficulties Ahead

APPROACH OF PUBLIC HOUSING as forecast anew by recent New York proposals for state or city financing of local housing operations brings many new problems into prospect. The startling cost level of the federal government's resettlement housing—$8,100 per house is reported for Greenhills this week, a cost matching that of Greenbelt—emphasizes these problems.

A decision must first be made between the philanthropic or charity plan, which is a part-payment poorhouse system, and fully self-supporting housing. Assuming that the charity plan will be limited to stranded or permanently submarginal groups, self-supporting housing presents the real problems. In this field public financing has the advantage of low money cost and large scale of operations, but in spite of this the fundamental problem of keeping the cost of housing within the income range will remain.

With standards set too high, no prospective reduction in first cost or operating cost can bring rentals to the level of the low-income purse; with standards set too low, the public will find itself forced into the slum-landlord business. To date no one has discovered how two to four rooms can be made to accommodate a large family in safety, decency and comfort. And, unless an extreme type of regimentation is adopted, the matter of placing each family into a home suited to its size and living requirements will be left to the family's individual choice, and this will be governed by costs and the family income.

Public housing enterprise promises no reduction in those costs that are due to design and construction. It can, however, deflate the land costs, always high in slum districts. It can also help to wipe out the current doctrine that part of the population must be content with a castoff-garment type of home. A determined trial of public housing is justified if it can be made to show that these results can be attained.

Ice Power

NOTHING IN THE HISTORY of ice effects on major structures matches the lifting and crushing of the famous upper arch at Niagara Falls last Thursday or the overwhelming of the Ontario powerhouse at the foot of the Canadian Falls. The bridge had stood in safety for forty years, and presumably no experience remembered at the time it was built gave warning of the danger that ice might jam up so high as to engulf and crush it. The powerhouse also, in a life of thirty years, had encountered nothing to warn of destructive ice attack at its sheltered location.

The wrecking of the arch was not a failure of the human element. It cannot be charged to inadequate plan or design. True, the arch was light; the close designing necessary because of limited funds produced a less rigid structure than might otherwise have resulted, as attested by annoying vibration during much of the life of the bridge. But if because of its lightness the bridge was crushed and pushed from its seat somewhat earlier than might otherwise have been the case, it is probably true that even the heaviest bridge framework would not have survived when caught in last week's tremendous jam of heaving floes.

Steel bridges, it is clear, must be kept out of range of such overpowering attack. While some ice hazards may be avoidable by building massive fender walls, strong enough to force the ice to crush itself against them, such protection is hardly adapted to the site of the wrecked arch. If the arch is to be rebuilt a different form of construction, with the low end sections built of masonry or concrete in a form sufficiently robust to resist both shove and lift, would seem essential for safety under such abnormal conditions as those just manifested.

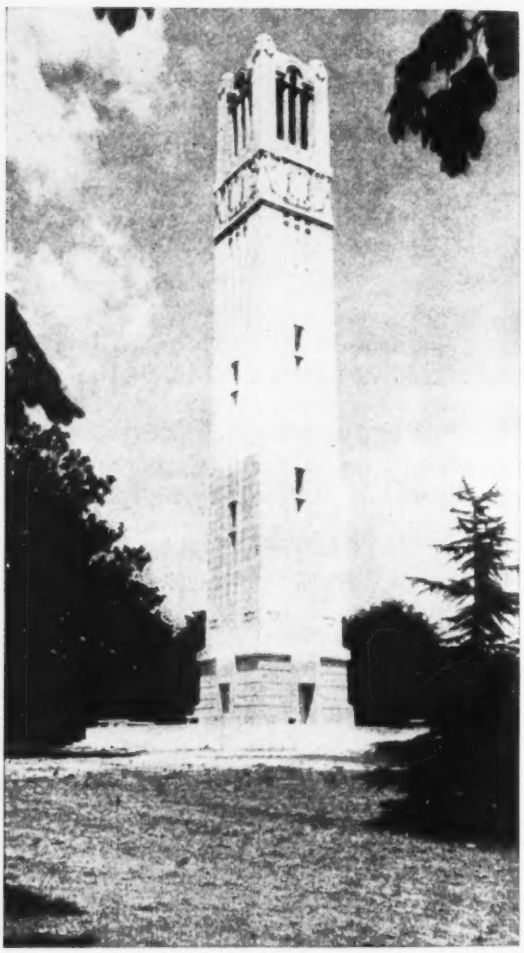
Rebuilding the bridge offers an unparalleled opportunity to create a structure worthy of its magnificent setting. No bridge site in the world equals this one for scenic grandeur, and none is sought out by as many admirers of natural beauty. The new bridge should be the highest embodiment of engineering and esthetic art. It presents an ideal occasion for a design competition planned to draw upon the widest possible range of creative conception and constructive genius.

PICTURES IN THE NEWS

REEVES NEWSOM, *New York consulting engineer, who is official nominee for president of the American Water Works Association. He will take office at the Association's convention in New Orleans the week of April 25.*

ENR Staff Photo

HANGING *the new sewage plant from the walls of the gorge at Niagara Falls required this ingenious feat for a stiff leg derrick.*



AN ENGINEERING COLLEGE *honors its war dead. Granite clock and bell tower 116 ft. high recently completed as a memorial to men from North Carolina College of Agriculture and Engineering, Raleigh.*

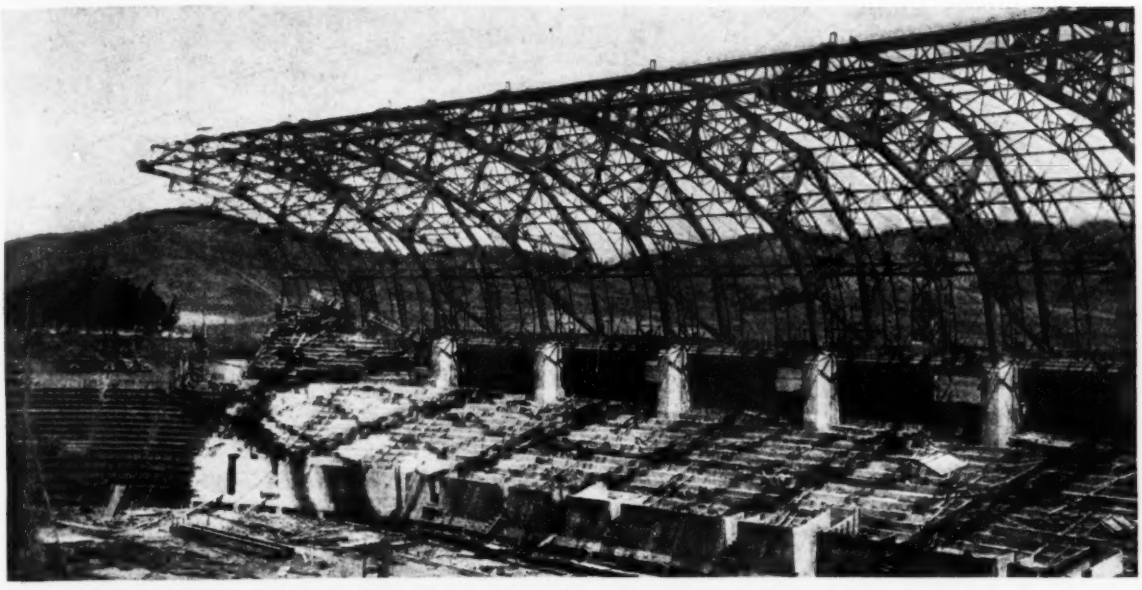


FIG. 1. CANTILEVER ARMS WHICH CARRY CENTRAL THREE-HINGED ARCHES OF CALIFORNIA EXPOSITION BUILDING.

Steel Roof Support has 300-ft. Span

To avoid column obstructions, large livestock arena at San Francisco carries three-hinged roof arches on steel cantilever arms anchored in stadium concrete

A STRUCTURE OF STEEL and concrete 300 x 400 ft. in plan now being built for use as an auditorium and livestock arena just outside the San Francisco city limits, has a highly unusual design in its roof supports which consist of three-hinged steel arches carried on steel cantilever arms anchored in the reinforced concrete of the stadium itself. Estimated to cost about $750,000, the structure is officially known as central unit No. 2 of the livestock exposition buildings now being constructed by Agricultural District No. 1A, a state-sponsored organization. Announcement of the project was made in *Engineering News-Record* May 27, 1937, p. 784.

In appearance the structure will be unusual because the redwood roof sheathing is carried by steel purlin trusses so framed that the top chords of the cantilever arms project above the roof, in this respect bearing some resemblance to exposed top chords of the Douglas airplane assembly plant described in *Engineering News-Record* Oct. 15, 1936, p. 542. The center pins of the three-hinged arch trusses are 101 ft. above the base of the cantilever arms, and since the cantilever arms rise over 80 ft. the arch itself is unusually flat.

The stadium, containing 10,000 permanent seats including the semicircular ends, completely surrounds a 142 x 237-ft. arena. Direct access to the stadium seats is had by means of numerous ramps from the ground floor level as well as through distribution passageways which extend entirely around the building at the back of the seats, 23 ft. above floor level. At the east end of the arena two vomitories connect the exhibit make-up areas on the ground floor; at the west end one connects to the main entrance floor.

Steel roof supports

The three-hinged arches and their cantilever supports are all framed with rolled sections. Top and bottom chords of the arch are 10-in., *H*-sections of various weights; web members are 10-in., wide-flange beam sections. The cantilever arms are somewhat heavier, using 14-in. *H*-sections throughout for chord and web members. The anchor arm of the cantilever, which is a continuation of the top or outer member, is carried down through the stadium concrete and anchored in the footings. The bottom chord of the cantilever terminates at a steel base plate on the stadium structure where it is held in place by steel anchor bolts extending well down into the concrete. All steel work is riveted; in arches where the gussets vary from $\frac{3}{8}$ to $\frac{5}{8}$ in. in thickness, $\frac{7}{8}$-in. rivets are used; in cantilever arms with $\frac{1}{2}$ to 1-in. gussets, rivets are 1-in. diam.

The arch pins are unusual in that they are carried in tapered roller bearings, thereby making sure that hinge action will occur. Diameters of the pins are $4\frac{1}{2}$ in. at the cen-

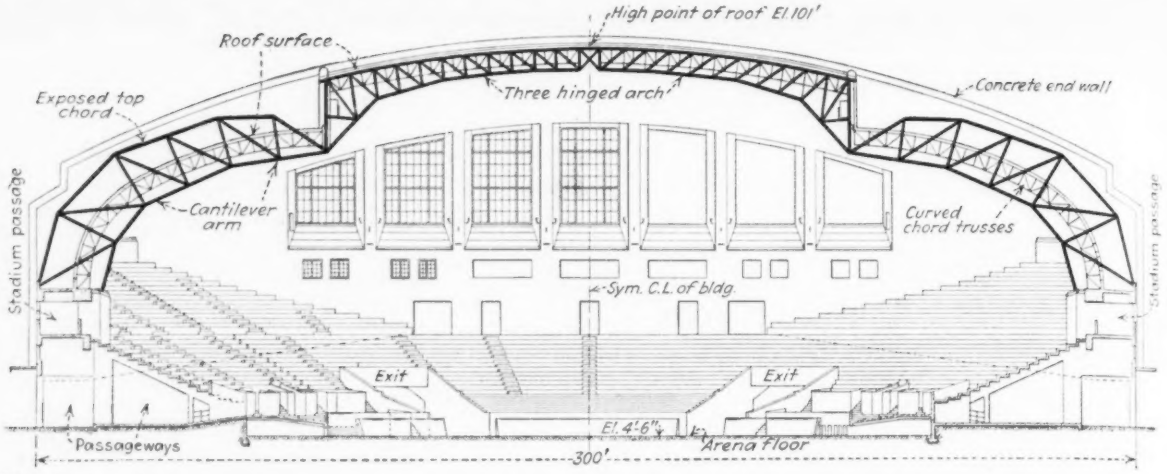


Fig. 2. Assembly of cantilevers and arch showing typical cross-section through auditorium. Cantilever chords project above roof.

ter of the arches and 5 in. at the ends. Arch reactions are taken wholly by the cantilever arms, thereby eliminating the usual tension ties between the bottom hinges. The heavy monolithic stadium construction is depended upon to resist all horizontal components of roof truss reactions and to transmit them to the foundation.

Roof loads are carried to the main trusses, spaced 37 ft. 3 in. apart, by steel purlin trusses, which in turn carry curved chord trusses parallel to the main trusses. The heavy 3 x 6-in. redwood shiplap sheathing of the roof is nailed directly to nailing pieces bolted to the top chords of the curved-chord trusses. The stress transfer path due to roof loads is therefore from sheathing to curved auxiliary trusses to purlin trusses to main arches and cantilevers and thence through the stadium structure to the footings. The purlin trusses are framed to cantilever arms in such a way that the top chords of the cantilevers will be exposed, giving the roof a rather unique appearance. Roof sheathing is articulated, being broken at all pin connections and at the end walls to provide for expansion and deflection in the structure.

Fig. 3. Detail at base of cantilever arm showing curved purlin trusses supporting roof sheathing.

Stadium structure

Reinforced concrete is used in the stadium and exterior walls, which are in general 6 in. thick. The end walls, by reason of the large area without lateral supports, presented a design problem which was solved by the use of two walls, 14 ft. 6 in. apart, connected by slab- and beam-framing. The supporting frame for these walls consists of pairs of columns at 24-ft. centers carried on combined footings. The elevated stadium passages for access to seats are carried between these walls. Cantilever roof truss reactions are carried by framed bents in the stadium structure, consisting of two columns spaced 17 ft. apart, connected by heavy walls and beams and carried on massive combined footings 35 ft. long. Both ends of these combined footings are interconnected longitudinally by heavy footing beams 3 x 5-ft. in sections.

The massive character of the construction is further indicated by the 4 x 5-ft. columns under the compression reaction of the cantilever arms. The sloping stadium floor is carried on girders supported by the framed bents and connecting girders under the truss reactions at one end, and by isolated columns at the arena end. A sloping tie-beam connects the arena end of all sloping stadium floor girders to the combined footings under the wall bents. Monolithic frames, spaced on 37-ft. 3-in. centers, are formed by the two

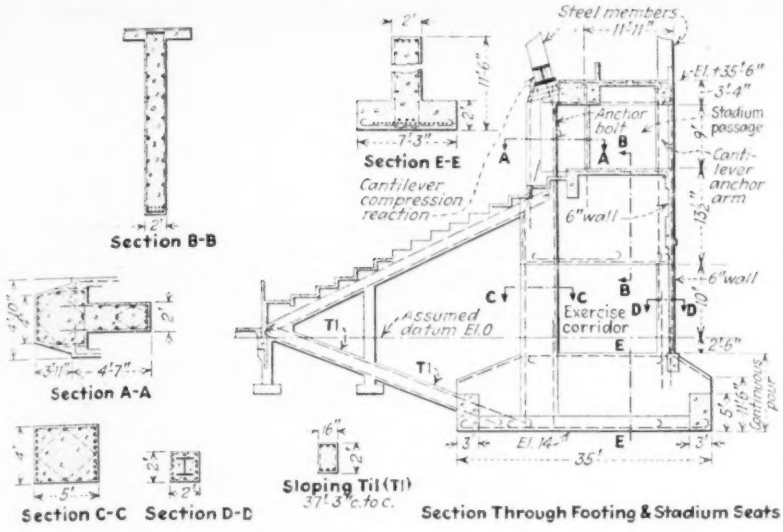


Fig. 4. Concrete foundations and details of stadium structure.

columns of each wall bent with their connecting walls, combined footing, sloping stadium floor girder, and sloping tie-beam. These frames provide for the cantilever truss reactions without any tension ties across the structure under the arena floor. The vertical columns, connecting walls, and combined footings are actually designed to take the full reaction; the stadium construction simply furnishes an additional safety factor. Footings throughout are so combined and interconnected as to insure continuous monolithic action of the stadium structure, which is of importance in an active seismic region.

Design requirements

The structure is designed to resist a wind load of 20 lb. per sq. ft. acting on the end walls and a lateral force of 10 per cent the weight of the structure acting transversely. (Wind load and a specified allowance for seismic forces are considered separately and are not combined; under California law the greater of the two governs the design of any structural member.) The floor of the concrete stadium structure is designed for a live load of 75 lb. per sq. ft. Concrete was specified to have a minimum strength in compression of 2,500 lb. per sq. in. at 28 days. The structure rests on a bed of highly stabilized sand and clay. The maximum soil pressure used in design, 4,000 lb. per sq. ft., was based on extensive soil tests.

Against transverse lateral loads the main truss units carry the stresses directly into the monolithic stadium structure. Diagonal rod bracing is used to provide for longitudinal lateral roof loads. End walls are designed to act independently, with expansion joints between walls and roof system. The two central bays, each 37 ft. 3 in. wide between the three-hinged arches, have diagonal rod bracing in all panels. Reactions from this bracing truss system are carried into similar systems between the cantilever arms except that here four 37-ft. 3-in. bays are braced instead of two. This tension rod truss system carries the lateral load into the stadium structure and through the reinforced concrete walls to the footings. Rods are all round, with upset ends that vary in diameter from 1 to 1¼ in., and the desired tension is maintained by adjusting turnbuckles provided for the purpose.

The group of livestock exposition buildings, of which this structure is a unit, is being built by Agricultural District No. 1A which has been formed to carry out a state project. W. D. Peugh, is the architect and F. W. Kellberg, is the structural engineer. Mechanical and electrical design were worked out by Leland and Haley, San Francisco.

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Mexico Pushes Roadbuilding Program

ENCOURAGED by the obvious benefits to national economy resulting from the profitable flow of tourist traffic over the Laredo-Mexico City highway, Mexico is devoting increased appropriations and activities toward extending the highway system of that country, according to a report to the Department of Commerce by the office of the American Commercial Attache, Mexico City.

Projects which are outstanding in the current program of the Mexico Government include the construction of a highway which will link Mexico City with Nogales, Arizona via Gaudalajara, a total distance of 1,553 miles. According to current plans, it is hoped to complete this highway by November, 1938, it was reported.

Another project included in the highway expansion program is the extension of the Pan American highway from Mexico City to Suchiate, a Guatemalan border town, covering a total distance of 901 miles from Mexico City, the report stated. The completion of this project will depend upon the availability of funds for this purpose, but it is expected locally that the grading for the roadbed as far as Talisman, near the Suchiate River, will be completed by the end of 1939, it was reported.

It was recently announced in Mexico City that 6,000,000 pesos in highway road bonds had been issued on November 1. Of the total proceeds derived from the sale of the issue, 3,000,000 pesos will be used in connection with construction work on the Mexico City-Suchiate project and the remainder will be used to meet additional expenditures.

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Water Collections Better

AS AN EVIDENCE of an upward business trend H. P. Bohmann, superintendent of the water department, Milwaukee, Wis., states that delinquencies this year placed on the tax roll for collection are only $1,574 as compared with $5,407 in 1936 and $20,000 two years ago.

New Zealand's Labor Experience

by EDWARD J. MEHREN
Chicago, Ill.

In forty years of experience New Zealand has found that compulsory arbitration and a wage floor are approved by employer and worker alike

Equipped with a rich background of experience, the author, formerly editor of Engineering News-Record, recently undertook a thorough personal study of how labor relations problems closely similar to ours have been worked out in a very different country, New Zealand, to find whether anything might be learned from what has been worked out there. In that agricultural and pastoral country, compulsory arbitration and a basic wage fixed by law have long been established; in addition, two years ago unionization was made mandatory. Upon inquiring of men of all classes—employer, employee and public—Mr. Mehren finds that the verdict is in favor of the system. On the horizon, however, he discerns some clouds. —EDITOR.

LABOR RELATIONS in New Zealand are at the moment colored by the effects of the depression and by the 1935 victory of the Labor Party and the subsequent advanced social legislation. It is important for clarity, therefore, to set down first the situation prior to 1930. At that time New Zealand had had the minimum wage and compulsory arbitration for forty years, the minimum wage law having been established in 1898, and compulsory arbitration in 1894. How did they work?

The employee answers, "Quite well." His wages had been raised to give him a decent standard of living. Hours had been cut down; 48 was the pre-depression legal maximum, though in most industries arbitration had brought it to 44. The exploitation of women and children in industry had been stopped.

The employer also answers, "Quite well." He has had relative freedom from strikes. And, quite remarkably, he cites as a second advantage the protection of himself against the chiselers in his own ranks; that is, wages had been eliminated as an element in price cutting.

The public was satisfied, for it retained in power the various governments responsible for this legislation. (These governments were "conservative" from the New Zealand point of view. We would call them "progressive." The present is the first Labor Government that New Zealand has had.)

Neither party would claim that the mechanism was (or is) perfect, yet neither would abandon compulsory arbitration and go back to unsupervised negotiation with its accompanying industrial warfare—strikes and lockouts. This position is the best evidence that the minimum wage and arbitration have given quite general satisfaction.

Conciliation mechanism

The mechanism of conciliation and arbitration prior to the depression (and now reestablished) was this:

1. Employers and employees in a given plant or industry attempted to settle their own differences by conference.

2. Failing such settlement either party could appeal to a Conciliation Council, consisting of representatives of both sides, with a conciliation commissioner as chairman (there were two commissioners, one for the North and one for the South Island, both appointed by the government.)

3. If either party refused to accept the decision of the Conciliation Council, the case was carried to the Arbitration Court, consisting of the judge, or chairman, one "assessor" representing the employers, and one "assessor" the employees. The decision of the court was (and again is) final. Enforcement was by fines upon either unions or employers for refusal to accept the award, and, theoretically and legally in the case of the unions by de-registration, which deprived the union of the right to represent its members in conciliation and arbitration matters.

It is not compulsory for unions to register and, failing to register, they do not come under the Industrial Conciliation and Arbitration Act. There is a mechanism of friendly conciliation outside the Conciliation Council and the Arbitration Court, but there is no penalty for failure to reach a decision in such negotiations. It was chiefly in the trades not registered that strikes occurred. The advantages of coming under the court must have been substantial, however, for the unions in all except a few of the important trades did register.

Before the depression unions existed chiefly in the skilled trades. Under the new law they cover practically all callings.

Wage details

Three different wage terms are used under the New Zealand laws. *Minimum* wages apply to all industrial occupations, whether or no the employees are in unions and whether or no the unions are registered. Since the compulsory unionization law was passed in 1936 minimum rates have little significance for industry.

The *basic* wage is the lowest that may be paid in occupations coming under the jurisdiction of the court, and is substantially higher than the minimum wage. It represents what in the judgment of the Arbitration Court, is necessary for a reasonable standard of living for a man, his wife and three children. The court is empowered to change the basic wage from time to time as the cost of living rises or falls.

Finally there are *award* rates, that

is, those that have been decided by the court as a result of hearings, or that have, by mutual consent, been registered with and approved by the court. Award rates in normal times are substantially higher than basic wages, the differentials being awarded for skill, for special geographic or trade conditions, and as a means of giving the workers a share in the increased prosperity of the industry. The latter argument, in support of requests for higher wages, is of recent introduction.

The basic wage that applied prior to the depression was set by the court in 1925 at 1s 10d per hour for unskilled workers (44c per hour or $19.36 for a 44-hr. week, at normal rates of exchange) and 2s 3d for skilled workers (54c per hour, or $23.76 for a 44-hr. week). Time and a half was paid for overtime and Sundays; full time, though no work was done, for certain statutory holidays.

Award rates were substantially above basic wages, while, in addition, it was and is customary for employers to pay superior workers wages higher than even the award rates. The unions make no protest against the payment of such higher rates. In fact, if they are commonly paid they give good ground for claims for an increase in the award rates, which, of course, apply to all engaged in given occupations.

Such were the conditions prior to 1930.

Then the depression

Then came the depression. New Zealand did not escape. The Nationalist Government struggled with its problems. Among other measures it reduced all wages in private employment by 10 per cent (including those not covered by Arbitration Court awards. The basic wage was practically inoperative, because it had been exceeded by rates on public work, which, in turn, had been generally followed.) Labor on public works was reduced 20 per cent ("Too much of a cut," commented a number of private employers in discussing the matter; a remark which is quite revealing regarding the attitude of the New Zealand employer.) Compulsory arbitration was abolished and compulsory negotiation substituted instead, on the theory that wages and employment conditions would thereby be more quickly adjusted to the depression. Strikes and lockouts were again legal in all lines, though, in fact, the number actually decreased. In New Zealand, as elsewhere, workers do not strike when jobs are scarce.

In the campaign of 1935 the Labor Party promised, among other planks, reduction in expenditures, higher wages, higher butter prices — and was swept into power. Then came advanced social legislation, including the taking of control of the Reserve Bank, a butter marketing plan under which the government buys the entire butterfat output of the farmers and undertakes to sell it, the fixing of prices of important commodities, a system of rent control, an expanded public works program to furnish employment, etc. But for purposes of this presentation its labor policy and legislation are the important items.

NEW Zealand has had arbitration laws that are compulsory for a large part of its trade unions for over forty years. It also has had minimum wage laws for a like period. Skilled craftsmen are rewarded by payment of rates higher than the agreed base rate, with no protest from the unions.

The verdict of both employees and employers is that the laws though not perfect have worked well. Wages have been maintained at living levels, exploitation of women and children does not exist, and employers find that the minimum wage laws have eliminated chiseling.

The public has recorded its approval by keeping in power the governments that set up these laws.

Labor policy changes

The new labor policy included:

1. The restoration of compulsory arbitration.

2. The re-establishment of the basic wage.

3. Compulsory unionization of all workers.

4. A 40-hr. week and increases in overtime payments.

5. Wage increases in two steps: first, by the restoration, as of July 1, 1936, of all wages to the 1931 level, and, second, effective two months later, by requiring the same weekly wage for 40 as for the previously customary 44-hr.

The 40-hr. week was not at once compulsory but only if and when the court decided that an industry could stand it. In fact, however, it is now quite generally in effect.

Time and a half is now paid for the first 4 hrs. of overtime and double time thereafter, time and a half for Saturday afternoons, and double time for Sundays even if the work on these days is within the 40-hr. maximum work week, treble time for holidays.

New basic wages, but only one for males and one for females, were declared by the court on Nov. 2, 1936: 3£ 10s. per week for males ($17 per week at normal rates of exchange) and 1£ 16s. for female workers. Confirming the previous statement that award rates in normal times are substantially higher than the basic wage, it is worth noting that award rates for unskilled workers are now about 4£ 13s. ($22.60 per week) and for skilled workers from 5£ to 5£ 10s. (from $24.35 to $26.75). As noted previously these rates are increased by employers for especially capable men.

Americans will note the rather small differentials between the rates for unskilled and for skilled workers, a result feared by our craft unions should they be superseded by the industrial type.

Under these newly imposed conditions what is the attitude of employer, employee and the public?

The employee is still satisfied with the wage and arbitration mechanisms and fairly well satisfied with present wages and hours. However, the frequency and size of new wage demands show that labor realizes that it is in the driver's seat and that it intends to press its advantage.

The employers are still satisfied with the mechanism, still believe that it is necessary and beneficial, but have some complaint not only of immediate conditions but of the

general administration of compulsory arbitration. They contend that the recent increases have been too rapid, that new demands are excessive and will be too heavy for industry, and consequently for the public, to bear. Price advances have already had to be made to cover increased wage costs, though it should be noted that these have not been great enough to cancel the wage increases. Real wages, therefore, are substantially higher than they were two years ago.

Arbitration against employers

As to the general administration of compulsory arbitration the employers state that it runs chiefly against them. They have assets from which fines can be collected should they refuse to accept an award. Further, it would be impossible for them to get other employees, and their plants would have to shut down. On the other hand, union assets are small and public opinion would not support imprisonment of large numbers of workers for contempt of court. De-registration, too, is not applied. In a number of recent cases the unions refused to accept court awards and struck, with the result that the government forced the employers to pay the higher wages demanded by the men which the court had refused to grant. It would seem, therefore, that the compulsory part of the arbitration procedure runs only against the employer.

Despite these criticisms, however, the employers still maintain that the arbitration mechanism is better than the older system of no mechanism, with more frequent strikes and lockouts. The labor leaders have, in general, good control of their men and are able to carry out their agreements. If this were not true, it is obvious that the great majority of cases would not be settled without either conciliation or arbitration. In view of this attitude of the employers it is evident that the abandonment of compulsory arbitration during the depression by the Nationalist Government was an emergency measure.

Finally, the public apparently is satisfied with the new conditions, though one must remember that under compulsory unionization large sections of the public are the beneficiaries of the new labor legislation.

No class cleavage

One question that naturally occurs to Americans concerns the possibility of cleavage between employer and employee. We fear that the introduction of legally supervised or legally compelled labor relations will discourage and ultimately eliminate that man-to-man contact and confidence so essential for sound labor relations. What has happened in this respect in New Zealand?

The answer is positive and unmistakable. Compulsory arbitration, in effect here for more than forty years, has not caused a cleavage between worker and employer. The man-to-man relationship persists. The greater number of questions is settled in the employer's own plant or in the industry itself without resort even to a Conciliation Council. Fewer cases still go to arbitration. The great majority of plants have never had recourse even to conciliation.

Nor is the attitude of the men independent because they can go to arbitration, because they have a legal method of getting a hearing. But neither is their attitude subservient. Every man here is as good as his neighbor, and the employer will assert it as quickly as the employee. Discipline in the plants is good, nor has it been seriously weakened by the triumph of the Labor Party. True, efficiency has declined recently. Most of the employers explain it, however, by the scarcity of skilled labor, though a few think it due in part to labor's political triumph.

All employers visited were outspoken in their praise of the loyalty, fairness and all-around decency of their men. (However, there was not opportunity to talk to mine owners and stevedoring companies, in which lines the chief labor difficulties have been experienced.) There was none of the complaining against labor organizations and unions that has generally accompanied employers' discussions of labor in the States and that has been particularly acrid in the past three years.

The unions, so far as could be learned, are not opposed to the introduction of labor-saving machinery. The specter of technological employment apparently has not raised its head here in a striking way. Piecework, however, though introduced in some industries and covered by awards, is not in favor with the unions. Where it is applied, they insist on having part in the determination of the rates, through the arbitration procedure if necessary, and, of course, once covered by awards the rates cannot be arbitrarily changed by the employer.

Skilled and unskilled

The wages above cited for skilled workers ($24.35 to $26.75 per week for the general run) are lower, it will be noted, than those paid skilled workers in the States. But it must be remembered that New Zealand is a country of more modest standard of living than America, that rents and food, at least, are distinctly cheaper. In other words, decent living costs less here.

On the other hand, considering differences in cost of living, the average award rates for unskilled workers ($22.60 per week) are distinctly better than was paid to our lower groups before the depression. In other words, the unskilled here are better off than ours, while the skilled do not fare as well.

Further, there are not such great disparities in income in New Zealand as with us. The workers clearly recognize this and tell you with pride that "there are no poor people in New Zealand and very few rich." Both parts of the statement are correct. Proof of the second part is found in the income tax returns. The government's Official Year Book for 1937 gives the number of persons with incomes (for the year ended March 31, 1934) of £1,000 and over as 3,773, and of £5,000 and over as 62. For the year 1936 it is estimated that 3,960 persons had incomes of £1,000 or more and 117 persons incomes of £5,000 or more. In considering these figures it must be borne in mind that the population of New Zealand is only 1,560,000.

The small number of large incomes is due to the size of the country, its youth (effective settlement began in 1840, less than 100 years ago) and to the character of its enterprise, which is chiefly primary

production—pastoral and agricultural. Its manufacturing industries are small.

It should be added that while no statistical comparisons of production could be found it was the testimony of both New Zealanders and Americans (the latter engaged in manufacturing here) that the American worker is a better producer, a better mechanic and more willing to accept improved tools and ways of doing work. In other words, he really earns more than the New Zealander.

Strikes

As had already been stated, strikes and (though rarely) lockouts do occur. In the years 1931 to 1935 inclusive there were 98 stoppages (and a few disputes involving passive resistance), 44 of them in the mining industry. Since the close of the year 1932, however, the number of stoppages in mining has decreased, leaving the shipping industry in the lead in number of acute disputes. The majority of strikes are of short duration, only five out of twelve stoppages in 1935, for example, lasting one week or more.

The results of strike settlements are worth noting. Of the 98 stoppages in the years mentioned, 14 were settled in favor of the workers, 36 in favor of the employers, 18 were compromised and in 30 the result was indeterminate.

In the five-year period noted, 32 stoppages were over wages, 3 over hours, 17 over employment (employment of non-unionists, dismissals, etc.), 27 over other working conditions, 11 were sympathetic strikes, and 8 were due to other causes.

Some special classes

The coal miners' and the waterside workers' cases obviously cause most trouble. The miners' leaders claim that they could not get improvement in working conditions at the hands of the court. Therefore, they de-registered and fought out the issue by strikes. Some of their leaders state that underground conditions and wages are now satisfactory. Nevertheless, the union has not re-registered.

The waterside workers very plainly are a thorn in the side of New Zealand labor. They restrict their membership sharply, and, though their wage demands have been granted, their work performance is low. Labor leaders state that this is due to the influence of Communistic elements in these unions—a group strongly opposed by the leaders of the Labor Party.

Because of the publicity given to the matter in America last summer a word should be said about the court's decision denying the basic wage and minimum hour protection to clerical workers. A bill to include them in the benefits of this legislation has now been passed. As a result nearly all employees in New Zealand, except domestic workers and a few odd occupations, are now organized. The law gives unionists preference in employment where unions exist. Attempt was made, though without success, to organize domestic servants.

Expansion of the social legislation beyond minimum wage laws and compulsory arbitration is causing much concern in New Zealand.

Increases in pensions, continuation of large expenditures for public works despite improved business conditions, and payment of such high wages on public undertakings that farmers cannot get field hands is a disturbing factor.

Much concern is expressed over the plans for extension of government ownership and operation which now includes power, railways and communications, to all productive enterprise.

Communism is bitterly opposed by many men now in power who hope to bring about wide socialization by the mechanism of democracy.

In conclusion a warning

The inference might be drawn from this report that employers in New Zealand are in a happy frame of mind, or at least not seriously disturbed. That inference would not be correct. They *are* seriously disturbed, but not about the principles of the basic wage and of compulsory arbitration, nor even about the defects in the operation of these mechanisms. What does disturb them is the advanced social legislation and policies of the Labor Government, such as increase in pensions, the continuance of a large public-works program despite the improvement in business, the payment of wages on public works so high that the farmers cannot get hands, a government housing scheme that is discouraging the private building of smaller dwellings, sharp increase in taxes to support these enlarged social services, the certainty that still further taxes will have to be levied to support the universal superannuation and medical and health insurance plans which the government expects to inaugurate, and finally the fear of further steps towards the socialization of industry, following upon industrial licensing and price control, already begun. In fact, during the inquiries on which this presentation is based it has been difficult to isolate labor relations from the new social and economic issues which the Labor Government's legislation and policies have created and which engross conversation and debate throughout all of New Zealand at the present time.

It should be added here that New Zealand has already gone far in government ownership and operation of public services, such as the railroads, the telegraphs, the electric power supply, the radio (all stations); and that socialization, i.e., government ownership, of all productive enterprise—industries and farmlands—is the program of the Labor Party. At the same time the leaders of the party, some of them in the present cabinet, are outspoken and bitter foes of Communism, which, they hold, is necessarily dictatorial and opposed to democratic institutions. They aim at socialization through the ballot, by the mechanism of democracy.

But from the studies made one fact stands out clearly: employer and employed have found the legally compelled mechanism of the basic wage and compulsory arbitration more satisfactory methods of labor relations than unsupervised procedure with its danger of strikes and lockouts, its losses in wages and output.

New Data on Pipe Joint Strength

by LEON SMALL,
Water Engineer, Bureau of Water Supply, Baltimore

Baltimore tests show that cast iron metropolitan type joints will safely sustain a pulling load of 25 tons

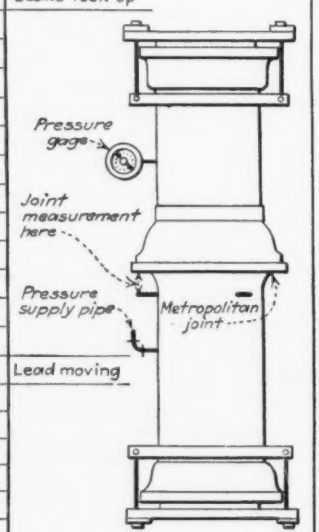
SPECIAL TESTS on the pull-apart strength of a 30-in. metropolitan type cast-iron pipe joint recently conducted by the Baltimore bureau of water supply show that a load of 25 tons can be safely applied. Data on this important characteristic was not available heretofore. The test, undertaken to determine the feasibility of pulling jointed pipe across a stream, included the determination of behavior under both hydraulic pressure and external loading.

The tests were made in connection with the installation of a new water main under Curtis Creek. In accordance with the specifications the contractor submitted an outline of the method by which he proposed installing the 1,200 ft. of pipe. The proposal provided for pulling pre-jointed sections across the stream. Two lengths were to be connected with a lead joint on a launching runway, and these would then be moved ahead by a cable extending to a deadman on the far side of the creek. This procedure was to be continued until the entire water line had been installed.

The submission of this procedure for the bureau's approval raised the question of the strength of these flexible joints. The manufacturer of the pipe stated that no tests had ever been conducted, and that they had no information indicating what load could be applied. It was decided by the bureau, therefore, to conduct tests prior to definite approval of the proposed installation plan.

TABLE 1 – TEST OF 30" METROPOLITAN JOINT

Pressure in pounds	Measurement at Joint A	B	C	Total Load in pounds	Remarks
0	$4\frac{1}{2}$"	$4\frac{49}{64}$"	$4\frac{49}{64}$"	0	Basic measurement before loading
10				10,044	
20				20,088	Weep at bottom
30				30,131	
40				40,174	Two leaks
50		$4\frac{13}{16}$"		50,218	Three leaks
60	$4\frac{1}{2}$"+.009"	$4\frac{15}{16}$"	$4\frac{25}{32}$"	60,261	
70	$4\frac{1}{2}$"+.021"	$4\frac{27}{32}$"		70,305	Leaks took up
80	$4\frac{1}{2}$"+.053"	$4\frac{29}{32}$"		80,348	
90	$4\frac{1}{2}$"+.057"	$4\frac{15}{16}$"		90,392	
	$4\frac{1}{2}$"+.080"	$4\frac{31}{32}$"			
100	$4\frac{1}{2}$"+.094"	$5\frac{1}{16}$"		100,435	
105	$4\frac{1}{2}$"+.117"	$5\frac{5}{64}$"		105,457	
120	$4\frac{1}{2}$"+.140"	$5\frac{5}{32}$"	$4\frac{13}{16}$"	120,522	
	$4\frac{1}{2}$"+.150"	$5\frac{1}{4}$"	$4\frac{13}{16}$"		
130	$4\frac{1}{2}$"+.166"	$5\frac{9}{32}$"	$4\frac{27}{32}$"	130,566	
	$4\frac{1}{2}$"+.169"				
	$4\frac{1}{2}$"+.180"				
140	$4\frac{1}{2}$"+.210"	$5\frac{13}{32}$"	$4\frac{7}{8}$"	140,609	
150		$5\frac{17}{32}$"	$4\frac{29}{32}$"	150,653	
160		$5\frac{43}{64}$"	$4\frac{31}{32}$"	160,696	Lead moving
	4.82"+.010"	$5\frac{3}{4}$"	5"		
	4.82"+.020"	$5\frac{15}{16}$"	5"		
170	4.82"+.070"	$5\frac{29}{32}$"	$5\frac{1}{32}$"	170,740	
	4.82"+.075"	6"	$5\frac{1}{16}$"		
180	4.82"+.150"	$6\frac{1}{8}$"	$5\frac{3}{32}$"	180,783	
	4.82"+.200"	$6\frac{1}{4}$"			
		$6\frac{11}{32}$"	$5\frac{9}{64}$"		
200				200,870	Joint broke



Test procedure

Two special lengths of pipe, each $4\frac{1}{2}$ ft. long, were obtained from the pipe manufacturer. One of these had a flexible bell and a modified Class C bell, while the other had a flexible spigot and a modified Class C bell. These sections were connected by means of a flexible joint made in the usual manner by first greasing the spigot end with graphite grease, pouring the joint with virgin lead and caulking. The two ends were then plugged with standard pipe plugs which were securely clamped.

After the sections were connected and caulked, the joint was deflected about 10 deg. and then brought back to a straight line. Measuring points were established around the joint at three places, located 120 deg. apart.

The test section was connected through a pressure pump to a fire hydrant on the distribution system. The pipe was then filled with water but before any pressure was applied the joint wept considerably, due to the aforementioned deflection, so that it was necessary to caulk slightly by hand before applying the test pressure. Hydraulic pressure was then applied starting with 10 lb. per sq. in. and increasing by increments of 10 lb. each; after each increase of pressure the movement of the joint was measured.

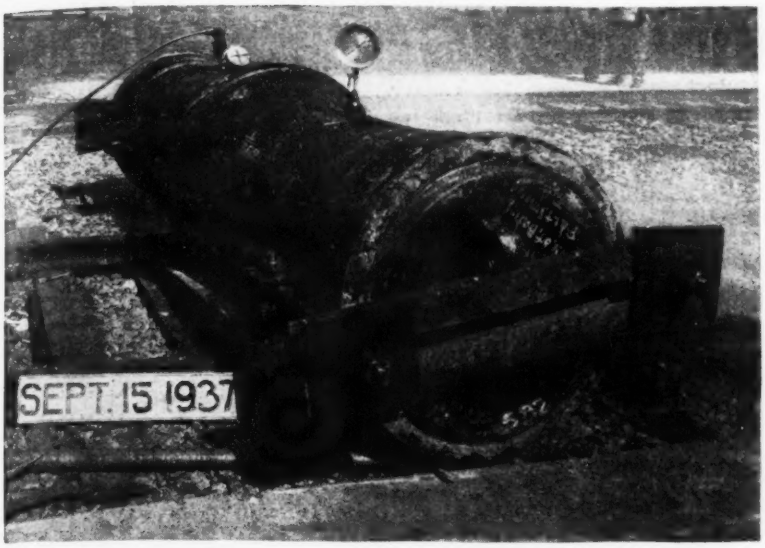


Fig. 1. Pipe sections joined and ends plugged ready for hydraulic test. Note the harness for holding the end plugs.

No appreciable movement was noted until a pressure of 50 lb. per sq.in. was reached, corresponding to a total load on the joint of approximately 25 tons, at which time a movement of 3/64 in. was noted at one measuring point. From then on, as will be noted from the accompanying record of the test (Table I), a constant movement was observed. In some cases several measurements were taken for a given pressure which indicated that the joint was moving steadily under such pressure. It is not known how much movement would have taken place had the pressure been held constant under these conditions.

When the pressure was increased up to 200 lb. per sq.in. the joint had moved so much that the lead was forced out on one side and pressure could not be maintained. It should be noted that the measurements at point "B" which was at the top of the pipe during the test, are greater than measurements at the other two points. This is evidently due to sagging of the overhanging end of the test section.

The total load in pounds as shown in Table I was computed by using the maximum ball diameter of the joint, namely, 35.76 in.

Load test behavior

During a discussion of the behavior of the joint under the preceding test, the question was raised as to whether there would be any movement in the joint if it were subjected to repeated load rather than a constantly increasing load. This led to the decision to conduct a test to determine whether, if there was any movement in the series of lifts, this movement would gradually become greater and, if so, the maximum amount.

Accordingly, the two sections of pipe were again connected as before. The test specimen was suspended in a vertical position from a crane to which it was attached by cables leading to the upper section. A platform was constructed of rail and loaded with pig lead in a sufficient quantity to make a total load, together with the lower section of pipe, of 15.5 tons.

This platform was then connected by cable to the lower section thus

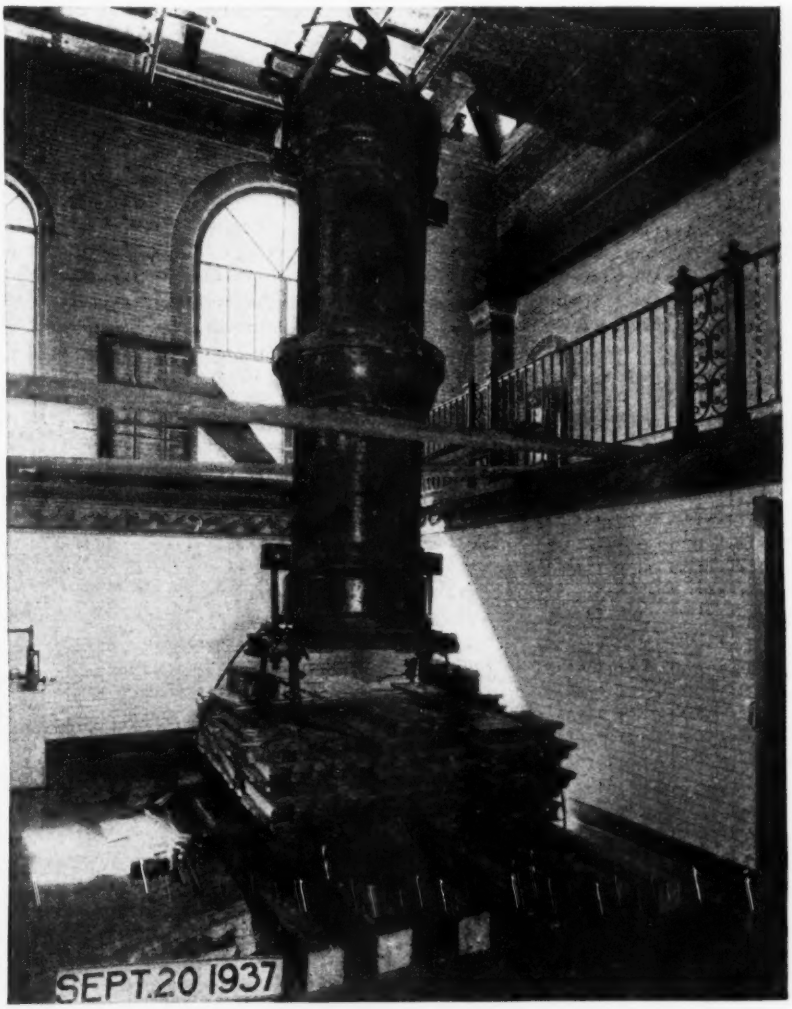


Fig. 2. Method used in testing joint strength under repeated loading. Using an overhead crane, the load was raised and lowered 100 times.

causing the flexible joint to support the entire weight. The load was raised and lowered 100 times without producing any appreciable movement of the joint. There was a slight movement of about 1/64 in. noted at the fiftieth lift on two of the three measuring points, after which there was no further movement observed.

The total load of approximately 15 tons was determined by the limit of the hoisting equipment with which the contractor proposed to pull the pipe across the river, as well as the fact that 15 tons is the rated capacity of the crane used in making the test.

Big Stone Lake Level Restored By Whetstone River Diversion

WPA engineers raise lake levels and effect flood control for Minnesota River by one operation

SOME seven years ago the water level of Big Stone Lake on the Minnesota-North Dakota state line began to fall. As the shore line receded, leaving an ever-broadening fringe of mud banks and wild vegetation, the recreational value of the lake likewise fell. Meanwhile, a few miles below the outlet of Big Stone, the Whetstone River continued to pour its spring floods from northeastern South Dakota into the Minnesota River, creating a part of the annual high water problem along that stream to its confluence with the Mississippi at the Twin Cities.

Due to the flatness of the surrounding country and the proximity of Whetstone River to the lake, as is shown in Fig. 1, it was seen that the Whetstone's flow could be diverted into the lake, thus restoring Big Stone's old level and at the same time providing a measure of control over spring torrents on the Minnesota River.

When the federal government launched its work relief program, the Whetstone diversion became the major public works project in that area. The project was completed early in the spring of 1937, and by July 1 the water level of Big Stone Lake had risen more than 8 ft., restoring the original shoreline.

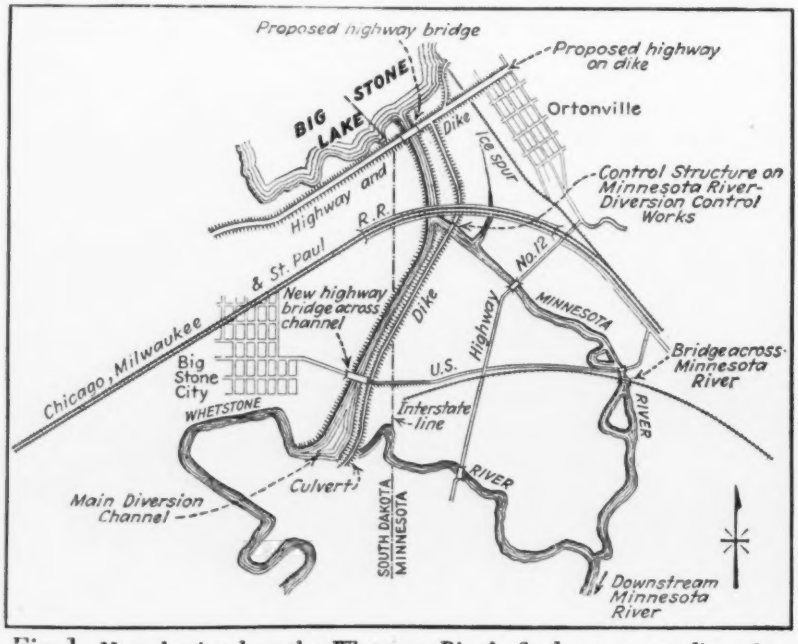


Fig. 1. Map showing how the Whetstone River's flood waters are diverted to Big Stone Lake.

The key to the project is a diversion channel about 4,100 ft. in length, combined with a concrete control structure, shown in Fig. 1. The diversion ditch varies in width from 180 to 300 ft., and is backed by an earth dike. The channel leaves the natural bed of the Whetstone River south of Big Stone, S.D., and follows a northerly course to the south end of Big Stone Lake near the source of the Minnesota River. The dike, which runs parallel to the diversion ditch, is about 60 ft. wide at its base and serves to protect the adjoining bottom land from overflow. The control structures can be so managed as to prevent the flow of water into the Minnesota during flood periods. At other times the gates are opened to permit escape of the river's normal volume.

A culvert in the channel of the Whetstone River at the point where it is turned into the diversion channel permits the normal flow of that stream to go down its natural course, a distance of about 2½ miles. A second dike skirts the southern bank of Big Stone Lake, crosses the diversion channel at right angles and forms the base for control of water in and out of the lake. This dike protects a railroad grade and is about 3,000 ft. in length. An additional 2,500 ft. of dike from the southeastern portion of the lake to the railroad grade protects the adjacent low lands from flooding, while a 300-ft. dike performs a similar function between the railroad dike and the eastern end of the control structure.

A timber bridge spans the diversion channel on the South Dakota side. Extensive riprap protection has been placed along the lake shore, at various points along the stream bed and around the river bridge. The Minnesota River channel below the dam has been cleaned, straightened and widened for a distance of about one mile.

The completed project has cost $180,000, of which amount $64,000 has been paid by WPA for relief labor. Non-relief labor has been paid $5,800. For other than labor items, WPA has spent $61,400, with sponsors contributing $29,400 for other than labor items. Expenditures reported by WPA of South Dakota, not detailed, total $19,400.

Incinerator Operation in a Southern City

by J. H. DINGLE
City Engineer, Charleston, S. C.

Automobile tires and battery boxes used for auxiliary fuel when burning wet refuse reduce oil consumption 90 per cent at Charleston, S. C.

ONE OF THE PRINCIPAL concerns in operating a refuse incinerator in a southern city is the disposal of combustion-retarding material which, due to climate and living conditions, is very abundant. Particularly acute in the summer months is the problem of handling rain-soaked mixed refuse and watermelon rinds. Due to a large negro population, melons are extremely popular in Charleston during July and August, and their low price encourages consumption. The inedible portions which reach the incinerator in large quantities, cannot be burned with much success.

In learning how to cope with situations of this kind, valuable operating experience has been gained. For instance, it was found that discarded automobile tires and storage battery boxes will serve as excellent auxiliary fuel to maintain high combustion temperatures. Consequently, these are now collected from service stations and stored for use when needed. Likewise, it has been learned that it is more economical to employ extra labor on the charging floor to segregate melon rinds for separate disposal, than to attempt burning them by use of the oil burners provided on the furnaces. Application of these practices has aided in reducing oil consumption almost 90 per cent.

Incinerator details

The Charleston municipal incinerator was built in 1935 as a CWA project, and has a design capacity of 240 tons per 24 hours in two furnaces. The plant contains a minimum amount of mechanical equipment since labor was favored for operation in preference to machinery. Designed by Metcalf & Eddy, consulting engineers, it has functioned satisfactorily beyond its rated capacity without offense.

Loaded trucks are driven to the third floor of the building, about 30 ft. above ground, over a ramp with a grade of 6 per cent. The trucks dump the refuse into bins which empty on the charging floor below. This separate dumping floor simplifies handling and eliminates truck maneuvering over garbage-strewn areas.

On the charging floor are six hopper openings, three each serving the furnaces below. The horizon-

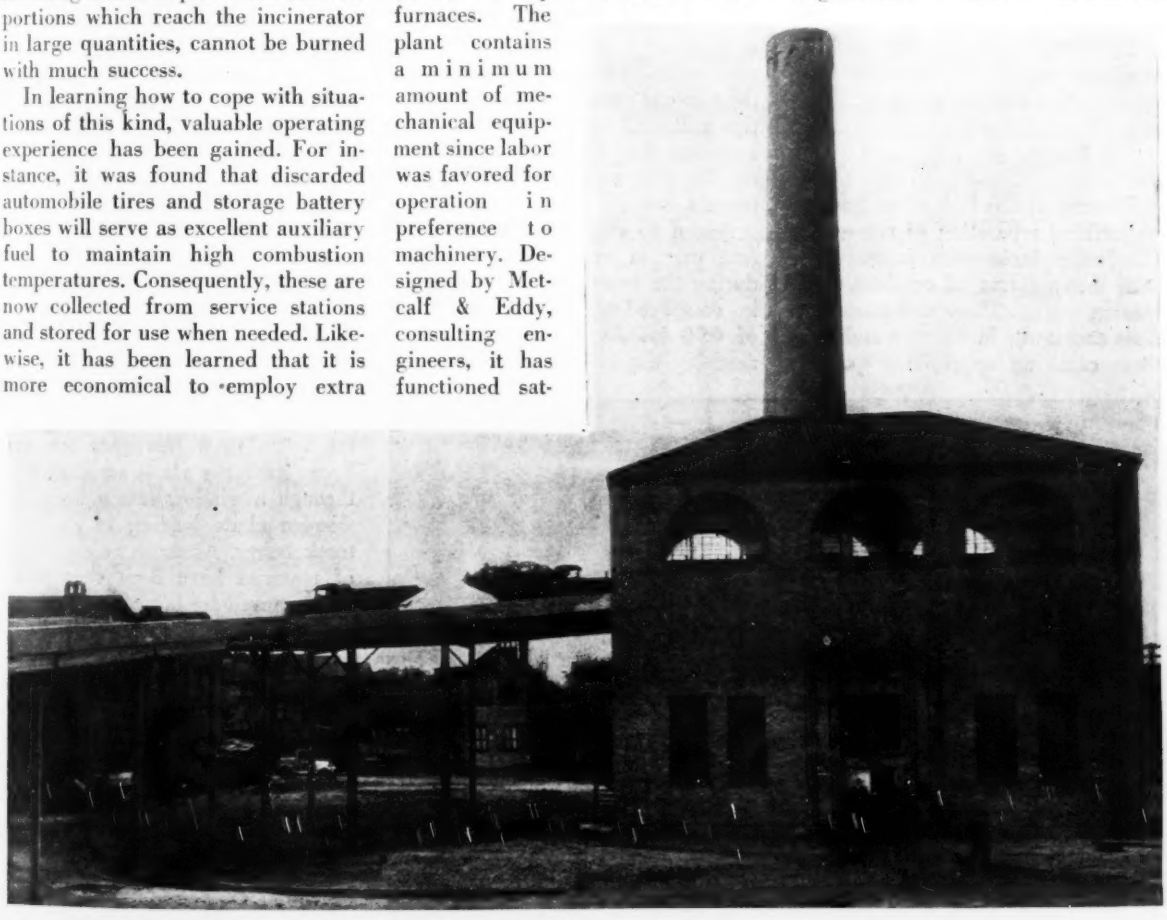


Fig. 1. An inclined ramp gives trucks access to the third floor of the Charleston Incinerator where refuse is dumped into bins.

tal sliding gate on each hopper is operated by individual electric motors controlled by the men on the stoking floor. Because the gates can be opened and closed quickly through a gear arrangement heat losses through charging are reduced to a minimum. This type of mechanism has many advantages over the customary air-ram devices.

The forced draft air supply is raised to the desired temperature by the admixture of free air with the hot gases drawn from the two combustion chambers by electrically driven fans. Each furnace has a separate forced draft mechanism.

Behind each of the six stoking doors of the two furnaces, a section of grate is hinged horizontally so that the front end can be dropped by the movement of a lever. Through this dump section the ashes, cinders, tin cans, etc., are dropped into the ash tunnel hoppers. These hoppers can be emptied directly into trucks which drive into the ash tunnel. The ash is quenched with water before it is driven to the dump.

Each furnace is provided with an auxiliary oil burner to assist combusion when necessary.

Refuse not separated

Because of the lack of ordinances prescribing separation of refuse, the Charleston incinerator is burdened with many forms of combustion-retarding matter. There are many gardens and lawns in the city and from these come an appreciable quantity of inoffensive but difficult to burn material. This class of refuse has a blanketing effect on the fires, and when collected in wet weather, requires the use of the auxiliary oil burner. Topping the list of unburnable refuse is the tonnage of melon rind reaching the incinerator during the summer months; the vast quantities collected seems to justify the assertion that the negro population of the city eats watermelon three times a day.

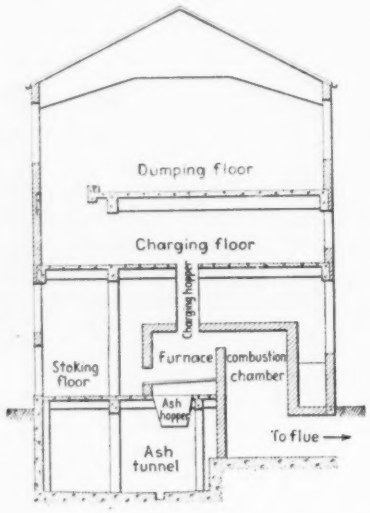


Fig. 2. Cross-section of the incinerator.

Added to these difficulties in the first year of operation, the rainfall during the month of July was 17.78 in. compared with a normal rainfall of 6.98 in. As a result the refuse reaching the incinerator was generally in a saturated state. The furnaces, with the assistance of the two oil burners consuming 40 to 50 gal. of oil each per hr., were able to slowly evaporate the moisture from the general refuse and render it combustible, but melon rinds passed through the furnaces with but little change and were unfit for dumping on the cinder pile. Even when placed in the combustion chambers, the upper layers of rind insulated the lower layers from the heat, and the net result was an accumulation of melon juice on the floor.

The furnace oil used during this first summer amounted to 53,205 gallons, costing $3,509. This led to the decision that special efforts should be made to secure and store combustible refuse for use as auxiliary fuel, and that in the future melon rind would be segregated from other refuse on the charging floor.

Segregation and fuel

As may be readily appreciated, the segregation of melon rind from a daily collection of 70 large truckloads of mixed refuse cannot be complete; however, it was demonstrated during the summers of 1936-37 that a noticeable reduction could be made. The method used was to station four extra laborers (called rindmen) on the charging floor. They were provided with a light steel rod, about 3 ft. long on which 3 in. of one end was bent at a right angle. As the charging floor laborers shoveled and dragged with their hoe-forks, the "rindmen" picked out the melons with their rods and flung them across the room to a pile near the wall. From here the rinds were shoveled through a window into a temporary wooden chute leading to an empty truck below. As much as eight loads of material have been thus picked and removed for burial in one day.

Foremost in the category of combustible refuse which was sought and specially collected and stored, were old rubber tires. These are of excellent fuel value. Local service stations supply the tires and as many as 1,500 have been in storage at the incinerator at one time.

One tire in contact with damp refuse in a furnace, will burn persistently for half an hour. Twelve such tires will keep a good fire in the six units of the two furnaces for an hour. The heat produced by

Fig. 3. Charging floor where the furnaces are fed through hopper openings with refuse dumped from the floor above.

the tires not only conserves furnace oil but at times renders the oil fuel unnecessary.

Automobile storage battery boxes also have considerable fuel value and until recently when they became valuable as "reclaim" material, have been collected and stored. When it is available, old tar paper roofing makes good fuel. Baled scrap paper which reaches the incinerator with regular collections is also set aside for use during unfavorable conditions of refuse and weather.

The extent to which tires, storage battery boxes and baled paper reduces operating costs is revealed by the reduction in furnace oil consumption. In 1935, for instance, 53,205 gal. of oil were used as against 5,954 gal. required during 1936.

Overall operating costs, despite increased labor cost, were reduced from $0.655 in 1935 to $0.642 per ton during 1936.

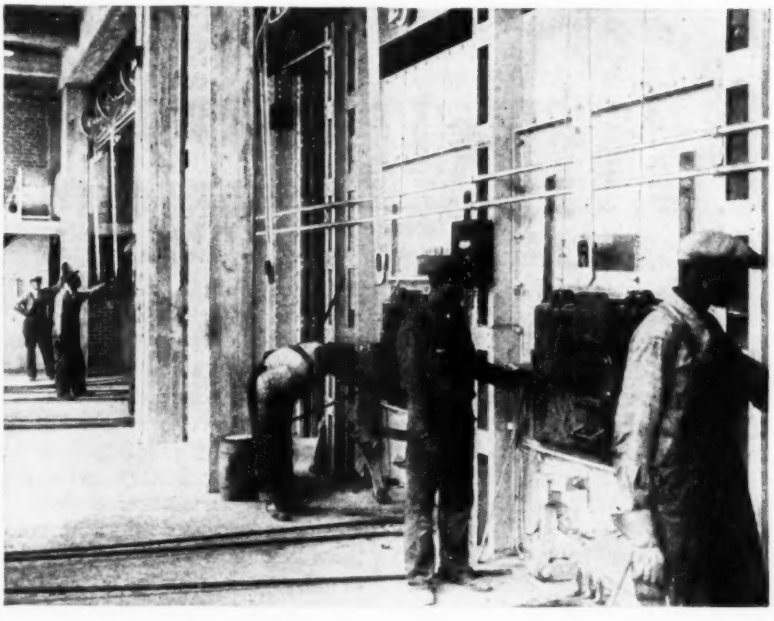


Fig. 4. Stokers using iron pokers agitate the burning mass to insure complete combustion. Each operator has a push-button control for charging his section of the furnace.

Fertilizer from ash

Ash-dust, from the combustion chambers, has some fertilizer value and is sold to a local processing plant. The fertilizing value of the ash is probably enhanced by the large amount of bones, small dead animals, and condemned seafood which are disposed of in the combustion chambers. A small amount of income is also derived from a concession for the salvaging of glass bottles. No other salvage is attempted.

Some condemned foodstuffs suitable for hog-feeding, such as flour, are given to local farmers. Incidentally, this is a good place to mention that loose flour has no place in a furnace. This was unintentionally demonstrated by a laborer, who swept a small amount of flour into one of the furnaces. The explosion which followed, happily, did no damage.

A word about safety. Shatterproof goggles are supplied to, and required to be worn by the stokers. This precaution is worthwhile because on occasion hard particles are expelled from the furnace with considerable force. Provision is now being made for the installation of guard-rails around the hopper openings on the charging floor. These were not constructed when the plant was built because possible difficulties in charging were foreseen.

For collection purposes the city is divided into two sections from each of which three collections per week are made on alternate days. Motor trucks with 1½-ton chassis are used. They are fitted with 4 cu.yd. rear dump bodies on which sideboards have been built to accommodate six or more cubic yards of refuse. Each truck carries a crew of one white operator and three negro helpers.

At the incinerator six to seven negroes under a white foreman operate the charging floor, and on the furnace floor a crew of six negro stokers are supervised by a white foreman. A superintendent, ash truck operator and ash tunnel attendant complete the plant personnel.

The Charleston incinerator is operated by the Department of Public Service of which the writer is engineer. J. Frank Morse is superintendent of the plant.

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Service Costs Rise In Large Cities

THE per capita cost of operation and maintenance of general departments of city governments of the 94 cities having a population of over 100,000 was $48.83 in 1936 as compared with $47.78 in the previous year, according to a recent report by William L. Austin, director, Bureau of the Census, Department of Commerce.

Cost payments for operation and maintenance of general departments, including those for the independent districts, totalled $1,838,803,017. In addition, payments amounted to $143,371,588 for operation and maintenance of public service enterprises: (water works, electric light plants, and similar services), $234,671,028 for interest on general debt; $119,443,707 for interest on public service enterprise debt; and $438,737,948 for outlay, of which $144,082,808 was for public service enterprises.

The gross debt outstanding at the close of the fiscal year for the 94 cities was $8,286,222,906 or $202.03 per capita. The valuation of taxable property in the same cities, subject to ad valorem taxes for city corporation was $57,012,931,855, or $1,514.00 per capita.

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House Razing in Milwaukee

IN 1937 Milwaukee demolished 720 structures as compared with 802 of the previous year, according to the annual report of L. M. Gurda, building inspector. This program eliminated 165 dwellings having housing facilities for 360 families. The others were commercial buildings.

Technical Discussions of Am.Soc.C.E.

American Society of Civil Engineers technical divisions consider cost of generating power, legislation affecting stream pollution, regional planning, fatigue tests on riveted joints, traffic problems and highway extensions in Mexico

A WIDE RANGE of subjects made up the program for sessions of the technical divisions of the American Society of Civil Engineers held in connection with the society's annual meeting in New York Jan. 19-22. Five divisions held meetings on Thursday, the power, sanitary engineering and structural divisions holding sessions both morning and afternoon, and the city planning and highway divisions holding half-day sessions.

A report of the general sessions of the society was published in our issue of Jan. 27, p. 123. In both the general meeting and in the technical sessions a considerable amount of attention was given to subjects of broad national interest.

Power generating costs

The cost of generating power by various means was the principal subject of papers and discussions in the symposium on cost of power held by the power division. This symposium is the second to be held by the division, the first being held in Pittsburgh in 1936, at which time the economic aspects of energy generation were discussed. The division now plans a third symposium on the ultimate cost of power to the consumer.

The symposium was opened with a paper by John C. Page, Commissioner of Reclamation, in which Mr. Page urged engineers to take the broadest possible view of the power problem. He said, "Public agencies have demonstrated in many localities that they can manufacture and distribute power efficiently and successfully with public benefit. Privately owned utilities have served as admirably in many other localities. Remembering that each power project is a separate problem and that because one method has rendered better service in one instance is not conclusive proof that another will not render better service elsewhere, has not the time arrived for engineers to concede that inherently there is nothing bad in either public or private ownership of electrical utilities, to accept the fact that either must earn its right to continued existence in any locality by efficient service in the public interest, to lay aside prejudices, and to apply themselves with the precise tools they have available in technical and scientific knowledge to the job of solving the power problem? Is it not time for engineers who play so prominent a role in the field of power to assist, honestly and wholeheartedly, in seeing to it that the public weal is placed foremost among the objectives of the power industry?"

Very useful data relating to the cost of heat-generated energy is found in a paper by C. F. Hirshfeld and R. M. VanDuzer, Jr., of the Detroit Edison Co., which was presented by Mr. VanDuzer. It deals with "Total Power Plant Cost," which includes the cost of labor, fuel and miscellaneous supplies, supervision, all allowances for depreciation, taxes and all overhead expenses. Figures given are for condensing steam turbine stations of the central-station type. In order to eliminate some of the unknowns introduced by variations in load factor, power factor, use factor and capacity factor, the latter is taken as dominant, with figures for anual capacity factor ranging from 20 to 80 per cent. Plant sizes range from 150,000 to 250,000 kw., and fuel costs are put at 15 cents per million B.t.u., which corresponds roughly to good grade bituminous coal at $4 per ton. Pressures range from 225 to 1,250 lb. and temperature ranges from 650 to 925 deg. F.

For these conditions the cost in mills per kilowatt-hour for plants with low pressure and low temperature ranges from around 16 mills for 20 per cent capacity factor to below 8 mills at 80 per cent capacity factor. For high-pressure, high-temperature plants, the costs range from around 12 mills to below 5 mills.

The investment in nominal 225-lb. plants was found to range between $85 and $110 per kw. capacity. The authors used $100 for the purposes of their calculations. Lumping all fixed charges, they were found to range from slightly under 10 per cent of the investment to as much as 14 per cent. The authors use 12 per cent.

Other sources of power

Speaking of other sources of fuel-generated power, the authors state that although mercury-vapor plants seemed to offer great possibilities a few years ago because of their greater thermal efficiency, there is reason to believe now that recent improvements in steam plants have offset the possible gains resulting from the greater thermal efficiency of the mercury-vapor plants due to the higher fixed investment in the latter. Diesel power plants are shown to have definite advantages where relatively small power stations are required. The authors give figures for costs of Diesel power but note that comparisons with steam stations are difficult due to the wide difference in size of stations, something like 10,000 kw. against 150,000 kw.

Looking to the future, the authors see opportunities for some improvement in the efficiency of existing types of power generating equipment. They also call attention to the almost unnoticed activity in the field

of fuel cells. One of the cells, which is somewhat similar to an electric battery in which fuel is consumed and electric power produced, is now operating in laboratory size in a very promising manner. Where it is operating was not stated.

In discussion, Prof. A. G. Christie of Johns Hopkins University laid special emphasis on the wide range in the cost of power stations, some being located in places where adverse physical conditions have to be overcome in order to be near a load center. Consumers, he said must be made to understand that generating costs are but a small element in the total cost to them.

Water power costs

A carefully prepared tabulation and analysis of the cost of 57 hydro-electric power plants was presented by Prof. H. K. Barrows of Massachusetts Institute of Technology. These plants range in capacity from 400 to 252,000-kw., in unit cost per kw. from $95 to $479 and in cost per kilowatt-hour from 1.6 to 37.4 mills. The average cost per kw. is $171, and the average cost per kilowatt-hour is 4.4 mills.

Professor Barrows, in analyzing his cost figures, pointed out that costs per kilowatt-hour are misleading when considered alone because hydro-electric power plants, generally, are most useful when integrated with steam stations or with other water power stations having quite different characteristics. For example, a hydro plant having fairly high unit costs can be used to carry peak loads in systems in which provision of equivalent steam power would be much more costly.

Included in Professor Barrows' paper are figures for the cost of power at some of the large power plants now being built by the federal government.

In discussion of Professor Barrows' paper, L. N. McClellan, chief electrical engineer of the U. S. Bureau of Reclamation, gave figures as to the cost of Boulder Dam power under the present power contract and under the proposed revisions in the power contract. The revision would cut the average cost per kilowatt-hour from 2.40 mills to 1.66 mills. Mr. McClellan stated that Professor Barrows' figure for the cost of power at other government plants is too low as it does not give adequate consideration to fixed costs during the period when a market is being developed.

T. B. Parker, chief construction engineer of the TVA, emphasized the need for considering a power plant as a unit in a system in order to get a correct evaluation of its possibilities. He noted that a plant having low unit cost may be less desirable in a particular system than one having higher unit cost but desirable output characteristics. Mr. McClellan took exception to the inclusion of Gilbertsville Dam at a cost of $110,000,000 in Professor Barrows' table of eleven TVA power projects, pointing out that it is essentially a navigation and flood control dam and has negligible power possibilities.

Further information on the possibilities of combining steam and hydro plants or hydro plants with different characteristics was given by Ezra B. Whitman, by H. G. Gerdes in a paper presented by L. F. Harza and by Philip Sporn.

Depreciation and obsolescence of power stations was discussed by five speakers, Maurice R. Scharff, consulting engineer, New York; James C. Bonbright, professor of finance, Columbia University; W. F. Uhl, hydraulic engineer with Charles T. Main, Inc., Boston; L. S. Lyon of the Brookings Institution, Washington, and Dean John B. Madden of the School of Commerce, New York University.

Stream pollution

Discussion of federal stream pollution legislation occupied an important place on the program of the sanitary engineering division, the members of which passed a resolution favoring the policies expressed in the original Vinson-Barkley bill, but opposing the amended form of the bill that has been introduced as a compromise measure in the Senate. The resolution stated that the amended bill would deter rather than promote pollution abatement. The board of direction of the A.S.C.E., to whom the adopted resolution was transmitted, took no action on the matter at this meeting.

Arthur D. Weston, chief engineer of the Massachusetts State Department of Health, in a review of legislative action for federal control of pollution, pointed out the original bill provided for cooperative action between federal and existing state agencies in making investigations and drafting plans for stream improvement. The compromise measure, however, goes a step farther and sets up a board of engineers who would divide the country into sanitary districts in which minimum pollution standards would be established. It also declares that the discharge of waste into navigable waters in violation of the board's regulations constitutes a public nuisance, which may be proceeded against by federal injunction proceedings after the expiration of three years from the date of announcement. These latter features, it was held, were too drastic and would deter rather than further the promotion of remedial measures.

Air sanitation

Air sanitation and industrial hygiene as integral parts of a public health engineering program, were outlined in a symposium in which papers were presented by Earle D. Phelps, Gordon M. Fair, J. J. Bloomfield, and Theodore F. Hatch.

Dr. Phelps, professor of sanitary science, Columbia University, pointed out that the engineer must know how to apply specialized knowledge in the fields of physiology, biology, chemistry, and toxicology, in order to adequately cope with air sanitation problems. While the physical application of control measures is an engineering matter, the air sanitarian is primarily concerned with chemical and biological factors affecting atmospheric environment and their relation to the human organism.

Prof. Fair of Harvard University agreed that engineers should be interested in air sanitation and industrial hygiene because of their relation to public health, but before the engineer seeks activity in these fields he must be carefully informed and trained. The water and sewage sanitarian, for instance, is not prepared to go with other fields unless additional training is obtained.

Industrial hygiene, which concerns itself with chemical, biological and physical factors affecting the health of workers, is a broad field calling for the cooperative activity of many different kinds of specialists, said J. J. Bloomfield, U. S. Public Health

Service. He pointed out that certain phases of this work are in the realm of engineering, such as ventilating, lighting and accident prevention. Other functions that call for engineering attention, such as development of instruments for making scientific studies, and the matter of setting up of standards, were pointed out by Theodore F. Hatch, associate dust control engineer, New York State Department of Labor.

That the engineer has long been identified with air sanitation matters was recalled by G. A. Soper, consulting engineer, who discussed experiences with early subway operations in New York. No provision had been made for ventilation, and the air was so hot and foul that for a time it was thought the subway would have to be closed to passengers and used only for freight. Following a study of conditions, adequate ventilation was secured by keeping the kiosks open and by installing street ventilators. These studies also showed that the air contained iron particles coming from brake action, the concentration of which averaged in amount one ton per mile per month.

Committee reports were made by Thomas H. Wiggin, who reviewed water supply progress, and by Harrison P. Eddy, Jr., who discussed the present status of refuse disposal practice.

City Housing

Housing occupied the center of attention of three papers given at the city planning division meeting. The theme of the papers, as outlined by the program, was The Functions of Planning Commissions in Cooperation with Public Housing Authorities.

William J. Fox, chief engineer, regional planning commission, Los Angeles, described studies for a project which has been referred to his commission for consideration as a means for housing unemployable indigents in Los Angeles County. Study was divided into design of dwellings, availability of sites, elements of cost and social considerations. In view of the fact that the project is for no-rent housing, rather than low-rent housing, the object of the design is a dwelling combining neatness, proof against vermin, ability to withstand hard usage, and an absolute minimum of cost. These should be immeasurable improvement over the low hovels now occupied by the group, and still should not make indigence attractive.

Sites available, mostly tax-delinquent land, would provide room for 100-house groups, 12-20-house groups, and single houses. A study of these 3 types of sites indicates that the middle-sized group is best, both from the economic and sociological standpoint.

Cooperation needed

Theodore T. McCrosky, formerly planning director on the city planning commission of Yonkers, N. Y., and now project planner with the U. S. Housing Authority, read a paper written from the viewpoint of his former job in which he defined the functions of the planning board and the housing authority. According to Mr. McCrosky, the two should work in close cooperation, but there should be a definite understanding of the functions of each. An important factor in attaining this cooperation and in maintaining distinction of function is the presence of a good leader, who should be a member of both organizations. In general, the local board is best situated to make investigations and surveys of conditions where projects are contemplated, while the U. S. Housing Authority is best equipped to use the data for design purposes.

The state housing authority's position was outlined by Joseph Nevin, of the staff of the New Jersey State Housing Authority. In his state there is "no real self-contained community" due to the density of population. For this reason it seemed advisable to have a state rather than a local housing authority. Because blighted housing conditions may be concentrated in one city and entirely absent in the adjoining one, however much that next might be affected by its neighbor's need, the state feels it should bear the cost of surveys and investigations that are properly paid for by the individual cities in many other states.

It is Mr. Nevin's contention that the present rate of house-building is not fast enough to overtake the rate of slum development. Regarding this, in the discussion that followed, there was some disagreement, one of those present contending that the slum situation in New York City, at least, is gradually improving due to the enforcement of the multiple-dwelling law. Others from New York, however, were not in complete agreement on this point.

Highways

Diversity of subject was offered to those who attended the highway division meeting. Papers were presented on N. Y. World's Fair Traffic, Mexican highways and highway safety. The first paper, written by John P. Hogan, chief engineer of the New York World's Fair, was presented by H. M. Brinckerhoff.

A daily capacity, including turnover, of 30 to 35 thousand autos will be provided for by parking spaces now planned and under construction at the site of the fair. In addition to these parking facilities, busses and taxis will be able to bring 25,000 persons per hour to the fair, and four rail utilities another 115,000 per hour. Highway arteries into New York and to fair grounds have been greatly improved by the completion of the Lincoln Tunnel and George Washington Bridge across the Hudson, the Henry Hudson Bridge across Spuyten Duyvil, the Triborough Bridge across East River, and an extensive system of parkways and express highways throughout the area. The Bronx-Whitestone Bridge will be complete in time for the fair.

Development of extension highways in Mexico was the subject of a paper by Senor Ricardo L. Vazquez, Director of General Roads, Mexico City.

Discussing traffic accidents, Earl J. Reeder, chief traffic engineer, National Safety Council, Chicago, stated that it is necessary to study accurate accident records to find spots where causes can be studied. The pedestrian problem is serious because the man on foot may not understand the limitations on automobiles, and he is often invisible due to improper lighting.

Because they carry more passengers per unit area covered, busses and street cars should be given room on the streets. Parking on the streets is undesirable, and should be removed to lots as soon as possible. Even loading and unloading of trucks should be conducted inside property lines, leaving room for passenger loading and unloading at all points on the curb. However, Mr. Reeder

pointed out, parking supervision is one of the most difficult police jobs.

Riveted joint tests

Endurance tests made at the University of Illinois at the instance of the authorities of the San Francisco Bay Bridge, with results of striking character and importance, were reported upon by Prof. Wilbur M. Wilson, research professor of structural engineering at the university. The tests indicated a much lower strength reserve of structures than is now accepted. In discussion, however, Jonathan Jones, chief engineer, fabricated steel construction, Bethlehem Steel Co., gave a reassuring view of the safety margin of bridges and other structures.

By means of a specially designed machine adapted to stress repetition or reversal up to 200,000 lb. tension and compression through an I-beam lever oscillated by an eccentric to apply direct load to a test specimen through a dynamometer, some forty riveted joints and control specimens were tested for fatigue failure. The load that would just break the specimen when repeated or alternated two million times was called "fatigue strength"; this figure was determined from three specimens loaded to slightly different stresses. The specimens generally consisted of one plate riveted between two others by 1-in. rivets, four to six in number, the midsection of the specimens being 7 in. wide and about 10 in. long between shoulders, and up to $\frac{3}{4}$ in. in plate thickness. Number of rivets and thickness of plates were proportioned to give different ratios of shear and bearing stress to tensile strength.

A number of tests on joints designed to fail in the rivets were not specifically reported, because of wide variation in their results. The author stated, however, that joints proportioned for shearing unit stress 0.72 of the tensile stress all failed in the plate, typically by cracks extending from the rivet holes.

In the main group of tests, plates of carbon steel, silicon steel and nickel steel were compared, the materials having ultimate tensile strengths of 63,000, 90,000 and 99,000 lb.persq.in. Their fatigue strengths were closely identical, about 26,000 lb. each. The joints had ordinary (carbon steel) rivets. One set of joints of silicon steel plates with manganese steel rivets gave slightly higher fatigue strength, while another set failed at nearly 20 per cent lower stress.

The strength of joints with subpunched and reamed holes or with drilled holes was no greater than the strength of joints with punched holes.

Comparing stress reversal with stress repetition, a limited set of tests showed reversal fatigue strength to be 19,700 lb.persq.in., strength under repeated stress varying from zero to maximum, 28,600 lb., and strength under repeated stress varying from half-maximum to maximum, 39,000 lb.persq.in.

Bearing stress up to $2\frac{1}{3}$ times the tension (joints with two, three and four rivets) did not affect the fatigue strength.

Tests on joints with one line, two lines and three lines of rivets showed slightly increased strength for the larger number of rivet lines.

Tests of a turned specimen of plate material compared with an unperforated plate specimen and another plate specimen containing a $1\frac{1}{8}$-in. hole in a 5-in. plate width gave relative fatigue strengths of 1, $\frac{2}{3}$ to $\frac{1}{2}$ and $\frac{1}{2}$ to $\frac{1}{3}$, the lower ratios applying to nickel steel. Prof. Wilson concluded that endurance tests of small polished specimens do not give an indication of the endurance strength of riveted joints.

The tests are shortly to be reported in full in a bulletin of the university.

Discussions raise questions

Mr. Jones, discussing the paper, asked the question whether evidences of fatigue failure are found in structures and suggested that bridges should be studied to discover possible fatigue effects. He cited two instances of phenomena that may be evidences of fatigue, one the cracking of a floorbeam web where cut out for the passage of chord eyebars, the other the apparent stretching of anchorage links of a cantilever bridge subjected to almost pure stress reversal at maximum stress of 8,000 lb.persq.in., which for a long time showed no trouble but in recent years showed clearance increased by $\frac{5}{8}$ in.

Mr. Jones cited a number of German test results and the specifications for unit stresses based upon them, together with the working stresses specified by the A.R.E.A. for reversed-stress members. The specifications indicate that current practice takes account of fatigue. The specifications for welded bridges of the American Welding Society, 1936, also take fatigue into account, by specifying for welded butt joints a minimum sectional area of max. minus $\frac{1}{2}$ min. divided by 13,500, but not less than max. divided by 16,000.

Leon S. Moisseiff, consulting engineer to the Bay Bridge Authority, spoke of the decision to advance bridge knowledge by a test program in connection with the Bay Bridge construction, and expressed the view that fatigue has been given thought in bridge design for some years past, both here and abroad, instancing especially changes in Russian practice.

H. W. Troelsch, designing engineer, American Bridge Co., pointed particularly to the test showing that high-strength steels have no greater endurance than carbon steel, but raised two pertinent questions: whether repetitive stress at lower loadings may not increase the fatigue strength for maximum loading, and whether the frequency of repetition affects the fatigue strength.

Prof. Hardy Cross, Yale University, characterized the investigation as the greatest piece of research Prof. Wilson has ever done. Despite the wide range of this pioneer study, all parts of the subject are not covered fully, he pointed out, and as fatigue is not evident in actual structures many questions remain to be explored. Do stringer-connection failures reflect fatigue or overstress, and what happens to steel during rest periods or when stress fluctuations are small, he asked?

Prof. Thomas Shedd, University of Illinois, after praising the ingenuity and driving power manifest in the investigation, suggested that tightness of rivets may have an important bearing on fatigue strength and that the result reported as to rivet spacing is not conclusive. The influence of ratio of minimum to maximum cyclic stress is a major question to be answered; also whether high-strength steels would show the same results on a small range of stress as on repetition of full stress. He pointed out that the findings as to the comparison of punching with drilling may be far-reaching when adequately confirmed by further tests.

Progress in Use of Treated Timber

Report by E. E. R. TRATMAN
Wheaton, Ill.

American Wood Preservers Association considers preframing of structural timbers, the economics of treated ties and poles, and termite protection

VARIOUS TECHNICAL, economic and commercial aspects of the preservative treatment of timber and the uses of treated timber were featured at the annual meeting of the American Wood Preservers Association, held in Chicago on January 18 to 20. Among uses of timber noted in a committee report was that of mats for soft subgrade, as installed experimentally on the Missouri Pacific Ry. Transverse timbers 3x10-in. and 14 ft. long are laid solid, and upon them are lines of longitudinal 2x10-in. timbers, the whole forming a base for the ballast. Another unusual application, for a similar purpose on the same railroad, consists of rows of piles driven in the side slopes of fills and connected below the subgrade by transverse tie-rods. Treated timber is used in permanent construction.

Timber in highway work

Extensive use of treated timber in work for highway construction and improvement, as outlined by V. L. Grover, engineer of materials for the Illinois State Division of Highways, includes bridges and trestles, guard fencing, posts for signs, retaining walls, bridge foundations, and fender piers. This state has now 360 bridges and trestles of this class. Typical large structures are the approach to the Illinois River bridge at Beardstown (33 spans and 1,090 ft. total length), and the trestle over the Lake Creek bottoms near Cache, Ill. (143 spans, 2,871 ft.). Both have creosoted pile bents with I-beam spans and creosoted plank floors. Present practice, however, is to use concrete floors, which hold the structure together more effectively and have much less wear and maintenance. The oldest structure, built in 1914, is still in service.

Southern yellow pine is the principal material used by the highway department but the use of Douglas fir is increasing. The original requirement for 10 lb. of creosote oil per cu. ft. has been changed to a minimum of 10 or 15 lb. for empty-cell and full-cell treatment respectively.

For salt-treated material (mainly guard-fence work) the specifications are open to zinc-chloride, zinc-meta-arsenite and Wolman salts. Experience with zinc-chloride indicates that the material must be stored long enough after treatment to season properly; otherwise there will be considerable cracking and checking. Rails for guard fencing are now required to be air seasoned. Cedar posts treated 12 years ago with ½-lb. of zinc-chloride per cu. ft. are still in good condition, even at the ground line. Salt treatment has an advantage if painting is needed.

Pre-framing of timbers

That preframing and preboring of timbers before treatment is justified economically, and that under an established policy almost all types and kinds of timber can be successfully handled, were the conclusions presented in a paper by C. J. Geyer, engineer, maintenance-of-way, Chesapeake & Ohio Ry.

To secure the greatest benefit, there must be a definite policy and a careful program. In one case, a field inspection of each bridge and structure is made in the fall by system and local officers, who determine on the ground the work to be done in the ensuing year. A program and budget can then be set up, and the purchasing department can secure the necessary material to replace that taken from the seasoned stock. The work can be spread over the year to allow of maintaining a uniform force.

With timbers for structures built to standard plans, the details of preframing are simple. For special structures, field measurements may be taken and sketches made to accompany the requisitions. On one road, stringer chords and framed bents are assembled at the plant for fitting and boring, and are then marked before treatment. For trestles more than one story high, diagrams are furnished to the erection forces. Posts are marked to indicate their positions in the bents. Caps and sills are distinguished by their different sizes, and braces are all marked. One road drives the piles first and then makes measurements for the other timbers, a refinement which seems to be justified by the additional service life. The treating companies and machinery manufacturers have been very helpful in simplifying these operations.

A railroad which now handles practically all its timber has an equipment valued at $24,000. Its tie dapper reduced the cost from 65c. per tie to 35c. In one year, this railroad framed more than 4½-million f.b.m. for less than $25,000, as compared with $76,230 estimated for hand work. Itemized cost per f.b.m. was $4.33 for bridge ties, $2.89 for trestle ties, $6.49 for structural timber, and $10.42 for miscellaneous, or an average of $5.36. The saving does not take into account the intangibles due to greater precision, or the salvage of blocks for floors, which were prepared at a cost of 1.4c. per block.

Economics of treated ties

The economic and service values of treated ties are now so well recognized that such ties represent a

large part of those in use and purchased for renewals. The economy is not only in the life and cost, but in the important matter of track maintenance, owing to the great reduction in tie renewals. Tie service records submitted in committee reports showed that on one road from 18 to 50 per cent of ties treated by various processes had been replaced in a period of 27 years, as against 100 per cent of untreated ties (90 per cent of the latter from decay). White birch ties have averaged 28 years when treated, while the untreated ties averagd only five years.

Experience with treated ties was reviewed by Robert H. Ford, chief engineer of the Chicago, Rock Island & Pacific Ry., which road has been using them for some 70 years, with results that have warranted a steady increase. Thus, tie renewals have dropped from 285 per mile in 1908 to 77 in 1937, with important saving in labor costs and better track condition. There is also to be considered the great depletion in sources of supply of first-class timber for ties. Inferior red-oak ties when treated have an indicated life of 25 years, and more than 30 years if prebored for spikes, pre-adzed and protected by tie-plates.

Poles, posts and piles

Factors that affect the life and economic service of treated poles were presented in a comprehensive paper by L. G. Smith, assistant to the general superintendent of the Consolidated Gas, Electric Light & Power Co., Baltimore, Md. Of about 350,000 southern pine poles purchased by utility companies in 1937, more than 90 per cent were treated with creosote and 10 per cent with ZMA. Of 138,770 cedar poles, 93 had butt treatment with creosote, 3 per cent with Anaconda paste, 1 per cent with Osmose, leaving only 3 per cent untreated. Annual purchase of poles ranges from 3½ to 4½ million, with about three million treated in 1936, of which at least one million were for utility companies. On transmission lines, the failure of even one pole may have serious results in interruption of service. In urban districts, stregnth of poles is important, as they may have to carry transformers, street lighting conductors, lamp brackets or other attachments.

A study by the Edison Electic Institute has shown that to a considerable extent the pole specifications of the American Standards Association and the treatment specifications of the American Wood Preservers Association are modified by purchasers, and certain changes in the specifications have been recommended. Creosoted poles are largely standardised, with butt treatment for western red cedar and full length treatment for southern pine. But pine poles have been treated with ZMA, and red cedar with Osmose and Anaconda paste. Records were given for several installations. That steaming of southern pine poles and timber causes a definite loss of strength was stated in a paper by S. J. Buckman and L. W. Rees. Although the trend is to air seasoning, the steaming process is still applied, not only to green timber but also as a preliminary to the creosoting of treated timber.

In view of differences of opinion as to whether the specifications for pressure treatment of Douglas fir poles, ties and lumber are applicable to western hemlock, mountain larch and tamarack, a committee recommended study of this subject. Another committee recommended that lodge-pole pine and western red cedar should be included in the specifications for pressure treatment of Douglas-fir poles, owing to the similarity of the woods. A report on nonpressure treatment dealt particularly with ground-line decay and the question whether to treat standing poles or to reinforce them with treated stubs. Records of treated posts were submitted and continuance of the present specifications for pressure treatment, pending further study, was recommended. Objections having been made to the specifications for treatment of southern pine piles, it was recommended that they be continued as tentative, to allow for further study.

Termites

The termite hazard, though often exaggerated, is a very definite problem in certain sections, and an evening session, held jointly with the Western Society of Engineers, was devoted to this subject. An address by Hermann von Schrenk, consulting engineer, St. Louis, Mo., dealt with termites in buildings and termite protection methods; it was supplemented by moving pictures dealing with termites and termite control on the Pacific coast. A committee proposed "recommended practice" for the use of treated timber in buildings as a means of protection against decay and termites. Poles also are subject to the attacks of flying termites it was noted that the ninth progress report on the international termite exposure tests has brought up to date information on the condition of test specimens of timber placed in Australia, the Panama Canal Zone, Hawaii and South Africa. The report states that the tests must continue for several years before any definite conclusions can be drawn.

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U. S. Has a Third of Roads And Two-Thirds of Cars

About 3,065,000 miles of highways, or nearly one-third of the world total of about 9,687,000, are in the United States, according to a survey of world highways just completed by the Automotive-Aeronautics Trade Division, Bureau of Foreign and Domestic Commerce.

In countries covered by the survey about 40,549,000 motor vehicles were registered, of which the United States had 28,520,500, or more than two-thirds of the world total on January 1, 1937.

At the close of 1929 the world total for highways was about 6,582,000 miles and the motor vehicle registration about 32,034,600 units. Thus, in a period of eight years the highway mileage of the world has increased more than 3,105,000 miles and the number of motor vehicles registered increased 12,028,400.

The use and the number of motor vehicles is progressing at a faster rate than the extension of new highways. In nearly every country highway authorities are faced with a steady growth of traffic congestion, due to inadequate street and highway facilities and the improper use of roads and streets for purposes other than the free movement of motor vehicles. A greater proportion of highway funds are now being used for improvement of roadways in congested areas with a resulting smaller expenditure for extensions, according to the Commerce Department.

Notes on Sewage Disposal

A monthly summary of current developments conducted by Willem Rudolfs

BACTERIA BIRTH RATES—Under certain conditions bacteria multiply rapidly after chlorination of surface water. This is explained on the basis of increased food supply available for the remaining organisms which may be hardier or more difficult to kill. Where food supply is available from organic pollution multiplication of bacteria after chlorine treatment may be so rapid and so great that after a relatively short period the total numbers are several times greater than before chlorination.

A similar phenomenon has been observed by Tressler (*Internationale Revue der gesamten Hydrobiologie und Hydrographie, 35, 178–186, 1937*) for plankton after copper sulfate treatment. He found that a large number of organisms are very susceptible to copper sulfate and are quickly killed, but the decomposition of these forms makes a very favorable medium for the increase of other hardier organisms; organic matter is liberated and carbon dioxide given off to the water. The forms which showed the most striking increase after the addition of copper sulfate were: *Cyclops, Diaptomus, Daphina* and *Anuraea.* Several other types resisted copper sulfate treatment or were tolerant to high dosages.

POISON REMOVAL—The effect of poisons discharged in industrial wastes on the organisms responsible for self-purification in streams is of importance, especially when complete treatment of such wastes is difficult. It is a well-known fact that poisons such as phenols and arsenicals will be decomposed to a large extent by organisms when these wastes are discharged continuously and in relatively small quantities. Recently it was reported that cyanides could be destroyed biologically (*ENR*, Nov. 4, 1937, p. 762).

The effect of chrome pickling liquors in a small stream was studied by Lieb (*Archiv. für Tygiene*, 118, 126, 1937). Although the poisonous effect of such liquors can be reduced by iron salts, only sedimentation was employed. Sludge taken from the stream was capable of absorbing chromates from the wastes. Quantities of potassium chromate in the waste, varying from 0.16 to 0.35 p.p.m., disappeared rapidly in the water. Sewage sludge also has a certain power to reduce the poisonous action of the waste. It appears, therefore, that certain quantities of chromate wastes can be discharged in a stream without poisoning aquatic life.

BOX BAFFLE—Sewage plant operators frequently find that considerable finely divided solids pass over the weirs of final settling tanks. A simple device to remedy this difficulty was constructed by O'Brien (*Report*, Ohio Conf. on Sewage Treatment, 1937). Originally the tank was equipped with influent baffles extending about 24 in. below the water surface; counterflow currents were noticeable and the effluent averaged about 22 p.p.m. suspended solids. A solid box baffle was then constructed in each tank over the influent ports, and extending from the water surface to within 15 in. of the tank floors. These box conduits direct the aerated sewage to the bottom of the tank and eliminate high velocity current. As a result, the tank became clear and the suspended solids in the effluent averaged less than 5 p.p.m. The water in the tank is so clear on occasions that the scraping mechanism on the floor becomes visible.

STARCH WASTE IRRIGATION—Every effort is being made in Germany to utilize sewage and waste for agricultural purposes. Potato starch waste consisting of wash water, and pulp press water and waste from the syrup process, containing sand, pieces of potatoes, fibres and large quantities of finely divided and soluble organic matter has a high oxygen demand, stimulates fungi growth and hydrogen sulfide production. Since the manufacturing of starch is seasonal the pollutional effect of these wastes on the stream or treatment works is intensified during a relatively short period. Lanninger (Reprint, Anklam, Friedland Works, Mecklenburg, 1937) reports experiments with disposal of the waste by means of artificial rain application on land.

About 11 million gallons of the waste, analyzing 138 p.p.m. nitrogen and 43 p.p.m. phosphoric acid, were pressure sprayed on about 300 acres of land. Through the fine division of starch waste in the air a large quantity of the soluble proteins were changed to foam, which remained on the surface of the soil so that the effluent from the drain pipes was practically free from organic material. In addition to providing a high degree of waste purification this scheme materially improved the fertility of the land since it added some 40 lb. of nitrogen and 12 lb. of phosphoric acid per acre.

SLUDGE GAS ENGINES—Utilization of gas produced from sludge digestion has been increasing rapidly in this country. At present 50 engines are used for pumping, air blowing, etc.; the more important American installations vary in size from 300 to 1200 hp. Walraven (paper before Oil and Gas Power Conference Aug. 1937) discussing the adaptation of gas engines to sewage sludge gas states that the amount of gas produced is equivalent to about 500 B.t.u. per capita a day. He found by experience that sludge gas may safely be used in engines with compression ratios of 6:1. With higher compressions he had no difficulty obtaining a fuel consumption of 10,000 B.t.u. per b. hp.-hr. when running under full load, and believes that these higher ratios may be used without fear of deterioration. Small quantities of finely divided sludge particles usually present in the gas should be trapped.

During 4½ years operation no trouble has been traceable to hydrogen sulfide which may be present in the gas. Heat recovered from the water jacket and exhaust gas averaged 75 per cent, sufficient to heat the digestors in severely cold weather. During the years 1933-37 the annual savings on electric current varied from $6,830 to $11,900.

THE WEEK'S EVENTS

(Continued from page 167)

Michigan Attacks Pollution Of St. Joseph River

The city of Niles, Mich., was ordered to begin construction of a $300,000 sewage disposal plant before May 1 by the Michigan Stream Control Commission on Jan. 18. The commission also ordered Berrier Spring and Buchana to complete plans by 1940, and the French Paper Co. of Niles was ordered to have its own disposal system in operation or to make arrangements to use the Niles plant by May 1, 1940.

The Commission thus took action against pollution of the St. Joseph River occurring in Michigan, preparatory to pressing charges of stream pollution, which have been pending for months, against the Indiana cities of South Bend, Mishawaka and Elkhart.

The St. Joseph River, which flows in Michigan throughout most of its length, loops into Indiana and passes through the three cities. The Michigan Commission says its tests show the river's pollution is seventy times greater when it flows back into Michigan than when it leaves the Michigan boundary.

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Site Acquisition Delays Friant Dam Project

The problems involved in acquiring water rights and a site for the Friant Dam of the Central Valley Project are the most complicated which the Bureau of Reclamation has ever faced. Walker R. Young, construction engineer for the bureau, told a Central Valley project rally at Tulare, Calif., Jan. 13. The complexity of the situation, he said, "grows beyond all reasonable limits," and the dam site already is the subject of three separate condemnation suits. The waters of the San Joaquin River have been in litigation for more than 75 years.

Despite the many difficulties, Mr. Young said good progress had been made and "he had not given up hope" that bids might be called for on the dam before the end of June. Most of the engineering problems have been worked out, funds are available in amounts sufficient to meet present needs, and the Bureau of Reclamation is ready to proceed as rapidly as local conditions will permit.

LOW DAM FINISHED AT GRAND COULEE

COMPLETED FOUNDATION of Grand Coulee Dam looks like this when seen from downstream. The first contract, covering the foundation structure, has been completed, and the base of the dam now rises about 177 ft. above bed rock. The last concrete on the contract was placed in the dam Jan. 10.

In the foreground, at the left, is the foundation for one of the twin power houses; the other power house foundation is at the opposite end of the dam.

Work will start soon on the second contract covering the high dam.

PERSONAL

J. H. JAMES, head of the department of chemistry at Carnegie Institute of Technology, will retire at the end of the present semester.

J. C. WARNER, associate professor of metallurgy at Carnegie Institute of Technology, has been appointed professor of chemistry and head of the department of chemistry there. The appointment will become effective July 1, 1938.

THOMAS J. SKINKER, in charge of street construction for the St. Louis, Mo. Board of Public Service, has resigned after 25 years in various city departments. He will be connected with the St. Louis branch of the Independent Concrete Pipe Co. of Toledo. Mr. Skinker has been with the Board of Public Service since last August, when he was transferred from the water department, where he had been in charge of the distribution system. He is president of the Engineers Club of St. Louis and of the joint council of the Associated Engineering Societies of St. Louis.

W. S. ORR, city engineer of Niagara Falls, Ont., has been named acting city manager there. Mr. Orr was for many years on the engineering staff of the Ontario Hydroelectric Power Commission.

LT. COMDR. HENRY P. NEEDHAM of the Navy civil engineer corps, has left his position at the San Diego naval operating base and has been assigned to duties in the Bureau of Yards and Docks.

HARRY S. ANDREWS, city engineer and commissioner of public works of Fulton, N. Y., has resigned to take an engineering position in Saranac Lake, N. Y.

GEORGE HACKETT has been named city engineer of Fulton N. Y.

WILLIAM MOON has been appointed commissioner of public works of Fulton, N. Y.

ROBERT HINES, area engineer of Pierre, S. D., for the WPA, has been appointed highway superintendent in Dawson County.

CALENDAR OF MEETINGS

NATIONAL SOCIETIES

American Concrete Contractors Association, National Concrete Masonry Association, National Cinder Concrete Products Association, Cast Stone Institute, joint convention, Hotel Sherman and Medinah Athletic Club, Chicago, Feb. 7-11.

Associated General Contractors of America, annual convention, Willard Hotel, Washington, Feb. 8-10.

Construction League of the United States, annual meeting, Willard Hotel, Washington, Feb. 11.

American Institute of Mining and Metallurgical Engineers, annual meeting, Engineering Societies Building, New York City, Feb. 14-18.

Association of Highway Officials of North Atlantic States, annual convention, Hotel Ambassador, Atlantic City, N. J., Feb. 16–18.

American Toll Bridge Association, annual convention, Hotel Chamberlin, Old Point Comfort, Va., Feb. 22-24.

American Society of Civil Engineers, Spring meeting, Jacksonville, Fla., April 20-23.

American Shore & Beach Preservation Association, annual meeting, Washington, D. C., April 19, and Jacksonville, Fla., April 21.

REGIONAL AND LOCAL

Association of Ontario Land Surveyors, annual convention, Royal York Hotel, Toronto, Ont., Feb. 15-16.

Southwest Road Show and School, annual session, Wichita Exhibition Building, Wichita, Kan., Feb. 22-25.

Arkansas Engineers Club, annual meeting, Hotel Marion, Little Rock, Feb. 25-26.

Iowa Engineering Society, annual meeting, Iowa City, Mar. 9-10.

New Jersey Sewage Works Association, annual meeting, Stacy Trent Hotel, Trenton, N. J., Mar. 10-11.

Section Meetings, American Water Works Association:
New York, Jamestown, Mar. 17-18.
Canadian, Windsor, Ont., Mar. 23-25.
Illinois, Decatur, April 5-6.
Indiana, West Lafayette, April 7-8.
Pacific Northwest, Spokane, May 19-21.

ELECTIONS AND ACTIVITIES

C. H. Coberly was elected president of the Colorado Society of Engineers at its two-day convention last month. Other officers elected are A. A. Matthews, vice-president, and C. M. Lightburn, secretary and treasurer.

At the annual meeting of the American Institute of Consulting Engineers held at New York Jan. 17, Dr. Dugald C. Jackson was elected president for the coming year. Robert Ridgway was reelected vice-president, and Philip W. Henry secretary and treasurer. The principal speakers at the dinner meeting were Rear-Admiral William H. Standley, U.S.N. retired, who spoke of the international aspects of world's fairs and of the 1939 New York fair in particular; and Col. A. Gibson, of the Chemical Warfare Service, U.S.A., who told of the origin and development of chemical warfare and its probable future influence.

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Short Course

Rutgers University College of Engineering, short course in "Sewage Disposal and Plant Operation," sponsored by the New Jersey Sewage Works Association, Feb. 14-26.

University of Maryland, short course in highway engineering, College Park, Md., Jan. 24-Feb. 4.

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License Examinations

New York: Examinations for professional engineers at New York, Albany, Syracuse and Buffalo, Feb. 1-3. Examinations for land surveying will be held on Feb. 4.

BRIEF NEWS

No direct cause for the cofferdam failure Dec. 19 at Port Stanley, Ont., has been found as a result of an investigation. Preparations are being made for immediate resumption of work on the $250,000 Jackknife Highway bridge.

All work on the railroads which the Mexican government is building will henceforth be done by Mexicans, including the work of engineers and other technicians.

A plan to end litigation that has been delaying construction of the Silver Creek water power project of the city of Sacramento has been proposed by the Pacific Gas & Electric Co., one of the litigants. Under the plan, the company would drop its federal court action to invalidate a $12,000,000 power district bond issue; would purchase the entire output of the power plant for 12 years, and for 40 years if the district so desires; and would pay the district about $900,000 per year for power, an amount which it is estimated would allow the district an annual net profit of $350,000. In return, the city would abandon its court action to condemn the company's distribution system and would build the Silver Creek plant under an agreement not to acquire a distribution system within 12 years.

The first of the steel towers which will support the main span of the Lions Gate bridge across the entrance to Vancouver Harbor is now under construction by the Dominion Bridge Co., the south pier having been completed. Erection of the 350-ft. tower will take about six weeks, at the end of which time the north pier is expected to be finished. Stuart Cameron & Co. are the substructure contractors.

OBITUARY

John Middleton, civil engineer and surveyor of Brooklyn, N. Y., died there Jan. 17 at the age of 74. Mr. Middleton received his education at Brooklyn Polytechnic Institute, the Columbia College of Civil Engineering, and the Columbia School of Mines.

Richard J. Arrand, 57, engineer and president of the R. J. Arrand Construction Co. of Saskatoon, Sask., died there recently.

A. H. Griffith, former district engineer of construction at Cincinnati for the Baltimore & Ohio R. R., died in Santa Monica, Calif., Jan. 18, at the age of 69.

Isaac S. Walker, Philadelphia consulting engineer specializing in water supply and sewage work, died in Philadelphia Jan. 23 at the age of 54. Mr. Walker, a graduate of Temple University and Drexel Institute, after holding minor positions in railroad and municipal work, became assistant engineer to the Philadelphia Bureau of Water in 1906. Shortly after being promoted to the rank of principal assistant engineer, he joined the New York consulting firm of Herring & Gregory in 1911. He remained with the firm for 6½ years, and then returned to Philadelphia as assistant engineer in the sewage disposal division of the Bureau of Surveys. He later became general manager of the Delaware Water Supply Co. and then the New Chester Water Co., becoming president of the latter firm. He entered consulting work in Philadelphia in 1930.

Frederick A. Roberts, engineer and wharfing contractor of St. Johns, N. B., in partnership with his father, died there recently.